The Electrical World.

VOL. XXXII. NEW YORK, NOVEMBER 12, 1898. No. 20.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.

Western Office, 936 Monadnock Block, Chicago.

Philadelphia Office, 929 Chestnut Street.

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FIELD EXCITATION OF ALTERNATING-CURRENT DYNAMOS.

The regulation of the voltage of direct-current generators with variable load is most readily accomplished by means of series windings which, as the load increases, build up the field magnetization to balance the drop in voltage which would otherwise occur, owing to various causes, such as the drop in speed, the ohmic drop in the machine, the reaction and distortion of the armature magnetization, etc. As a rule, the compounding effect is even made greater in order to balance out also the line drop. With alternating-current machines of large sizes this system is impractical, and what is worse, the drop in an alternating-current machine is likely to be considerably greater than in a direct. This is due in part to the fact that the self-induction of the armature winding adds to the ohmic drop, and if, for any reason, such as the use of motors, the load becomes inductive, there is a demagnetizing tendency of the armature which does not exist to any extent with direct-current machines.

Combined light and power alternating systems, especially those competing with Edison installations, wherein the voltage regulation is commendably perfect, are clamoring for closer and closer regulation, and insist of late on a 5 per cent. drop in a machine as a maximum between no load and full load non-inductive. Even with this their troubles are not ended, as with increase of load, the various drops of speed, machine, line and transformer impedance combined necessitate a wide range of the field-resistance adjustment to give constant potential at the lamps; so that a quick change of load or of the power factor of the load, such as may occur with induction motors driving elevators, for example, causes a noticeable variation of the candle power, no matter how quick and expert the switchboard attendant may be. Any means of reducing this necessary variation of the exciting-current strength offers an improvement in such machinery even if the actual regulation of the machine remains the same. Such a means is the expenditure of the magneto-motive force of the exciting coils on the air gap instead of the iron of the magnetic circuit. In other words, a machine with a high-reluctance air gap and an unsaturated magnetic circuit will give better regulation with combined light and power loads than will another machine of the same capacity with the same watts in the exciting coil, but with a narrow gap of large area and a saturated field.

The reason of this may be explained somewhat as follows: The demagnetizing action of the same load on the field magnets of the two machines would be the same and would require exactly the same increase of ampere turns in the two fields, but the reactive drop in the armature, the drop in the speed and the drop in the line would require a much smaller variation of the exciting current and a consequently smaller change of rheostat in the case of the machine with the wide air gap, as this machine would work on a much steeper portion of the magnetization curve, and a given percentage variation of the exciting current would cause, therefore, a greater percentage variation of the voltage than in the case of the other machine. Incidentally also a wide air gap reduces the self-induction of the armature somewhat, a gain which can also be made use of by the finer distribution of the windings by the use of narrower teeth and slots and more of them.

As between two machines with the same iron, the one having a wider air gap than the other, the same principle applies at a given density; the one with the wider air gap has a steeper magnetization curve and its voltage is consequently adjusted with a smaller variation of the series resistance in the field circuit. In this case also the proportion of the field to the armature ampere turns is greater, because of the increased field magneto-motive force necessary, and on this account any increase of the energy load or addition to the reactive load causes a smaller internal drop. As between two machines of the same gap, but with different cross-sections of iron, the one with the lesser iron running above the bend of the magnetization curve and the other below, that with the over-saturated iron will require a greater exciting current, and will therefore have a greater ratio of field to armature ampere turns, which is an advantage; but that with the more iron will have a steeper magnetization curve, which in itself is an advantage. The best combination for regulation purposes seems to be that of a wide gap—from one-half to three-fourths of an inch—with unsaturated iron, and the design of a machine that requires a very small percentage of its output for the excitation purposes is not a thing in the present state of the art to be proud of, as many take to be the case. Such a machine with a wide gap is expensive, good regulation in alternating-current machinery being with present methods much more expensive than in direct, requiring under any circumstances a high ratio of field to armature ampere turns, which means a large amount of material and unfortunately a large iron loss for a given output, since in general this ratio is obtained not by any change in design or construction but by the simple process of scaling down the rated output 25, 30 or 50 per cent. below that imposed by the heating limit.

HIGHER TROLLEY VOLTAGES.

Whenever a street railway system extends to points so far from the power house that the copper required for proper feeding begins to alarm its management, recourse is usually had to one of several makeshifts; new power plants are installed, boosters or storage-battery sub-stations are put in, or a three-wire system or an alternating-current rotary-transformer system is installed. There are numerous excellent interurban and suburban railway projects under discussion whose realization is hampered by the short reach of the ordinary 500-volt distribution, and whose projectors are daunted by the disadvantages of each of these various alternative plans. A simple, but so far untried, solution of these difficulties is the raising of the voltage.

This may seem a crude and dangerous cutting of the Gordian knot of difficulties which beset roads too long to be properly worked from a single source of current supply, say 500 volts, and too small or with cars too scattered to justify sub-station work; but it is in some respects a better way to solve the problem than any now in vogue. There are difficulties, of course, but these are for the most part imaginary. There is nothing sacred about a 500-volt pressure. It was adopted for a standard ten years ago, being as high as its adopters dared to go, and great were the difficulties it led them into at that time. But conditions are different now, so that were present apparatus by some miracle to be swept away and with it the 500-volt mental habit of the street-railway engineer, a great deal higher standard would probably be adopted. The advantages of a high trolley voltage are simplicity and low cost of long feeds. The disadvantages are danger, difficulty of insulation and difficulty of control. Probably no one will dispute the advantages, which are self-evident, the doubling of the voltage, for example, reducing the copper required for the same distance and loss by 75 per cent., or allowing the same cars scattered over lines of twice the length and an area four times as great to be supplied with the same copper. The disadvantages for cross-country lines are by no means as great as they seem.

The matter of the danger of high trolley voltages has recently been brought up in Switzerland in connection with the proposal of Messrs. Brown, Boveri & Co. to use 750 volts alternating on several three-phase trolley lines, the conditions of which are even worse in some respects than those of direct-current work, owing to the fact that there would be two trolley wires close together with a pressure of 750 volts between them. To dispel the fears of the Swiss Railway Commission, advice was obtained of three experts, Messrs. Gisbert Kapp, Silvanus Thompson and H. F. Weber. The first considered that 750 volts was no more dangerous than 500, as the latter had been known to give fatal effects, and argued that on account of its apparent security it was really more dangerous than the higher voltage, which would secure greater respect, an argument that would perhaps not appeal to American workers on tower wagons who are never seriously hurt by 500 volts, but would be likely to be by the other. Professor Thompson also considered that the satisfactory working of trolley pressures up to 1500 volts was only a question of careful engineering. The third expert considered these high pressures perilous, but small compared with the other dangers of high-speed railroad running, and justified by the advantages which might be derived.

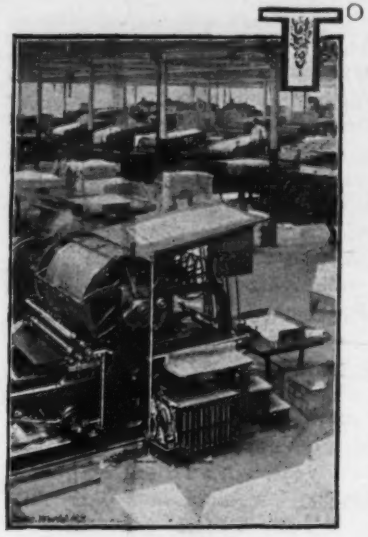
Insulation is not a real difficulty. Of course, more strain insulators would be needed in the line and more care in the insulation of the motors. For long-distance work the latter, however, are generally of large size, running double-truck cars at high speeds, and the insulation is comparatively easy with the increased room. To manage large currents at these high pressures, the controllers might require further modifications, but there are ample opportunities for quick-break devices and other improvements to solve this problem. The greatest difficulty would be to obtain a system whereby the same cars could be run at high voltage in interurban and suburban work and at low voltage in the city streets. On account of the desired difference in speed the same motors might work well at 750 or 1000 volts on suburban lines and at 500 volts on the city streets, the only difficulty being with the electric lighting of the cars, a detail which might be worth abandoning on account of the advantages to be gained. Now that four-motor equipments are coming into considerable use for heavy, long-distance service it would be a simple matter to arrange the motors in pairs, the two of each pair to be worked in series on the 1000-volt lines and in multiple on the 500-volt lines, by means of a single throw-over switch, the two pairs to be worked together with the ordinary series-parallel control.

THE ENTERTAINMENT ACCOUNT.

A pernicious custom apparently inseparable from competition, and one which is perhaps followed to a greater extreme in the sale of electrical apparatus than in any other line of transactions, is the practice of treating. The prospective buyer of a boiler, engine or dynamo, his engineer, architect or agent, is transported about the country nominally to inspect similar installations, dined and wined and made the object of an outrageously wasteful expenditure of money in many other ways. Unfortunately, this process in the case of large orders is a cheaper method of obtaining business than the use of high-grade material and workmanship in the construction of the apparatus. It thus gives unprincipled manufacturers an advantage which must be met by those attempting to maintain a high standard by similar tactics, necessitating either an increase of prices or a deterioration of the quality. The commonsense purchaser must realize that a manufacturer who does not stoop to such practices can supply a better equipment at the same price with the same profit than the one who spends a considerable percentage of the contract price in "blowing off" the prospective buyer, but more often the one treated is an agent or consultant who cares more for this petty form of bribery than he does for his employer's interests. The practice is a degrading one, both morally and industrially, but for its eradication we will probably have to wait until the millennium.

The Electrical Equipment of a Model Printing Establishment.

BY GEORGE A. DAMON.



TO even a casual observer the part which electricity is playing in industrial movements is an interesting study. The concentration of great manufacturing establishments about water powers and the opening up of vast suburban districts about our cities by means of the rapidly moving electric car are everyday instances of the influence of electrical development upon constantly changing industrial conditions. Perhaps less evident, but none the less important, are the changes which are brought about by the use of the electric motor in the operation of manufacturing establishments, a notable example of which is described below in a reprint, slightly abstracted, of a paper read before the Chicago Electrical Association, November 4, 1898:

There are few instances where the adoption of electric power has led to such a radical departure from ordinary methods or where greater advantage has been taken of the possibilities of electrical operation, than in the model printing establishment of the W. B. Conkey Company, at Hammond, Ind. The operation of this immense plant in its former location, the centre of a great city, presented many disadvantages. Taxes were necessarily high, insurance rates oppressive, and the cartage of raw material and finished product to and from the depots through a congested business district was slow and expensive, while its movement by the railroads was unsatisfactory. The mill construction of the buildings, their location with respect to surrounding structures, and the extent of floor space employed made it necessary to supply artificial illumination to many parts of the factory during the entire period of operation. The relative location of the buildings made it necessary to maintain two distinct plants for power, heat and light. Power was transmitted from the engine flywheel to the various machines by means of belts and rope drives. By actual tests fully 45 per cent. of the power delivered by the engine to the main driving shaft, at average load, was used to run the shafting, and this transmission loss was, of course, much larger at lighter loads.

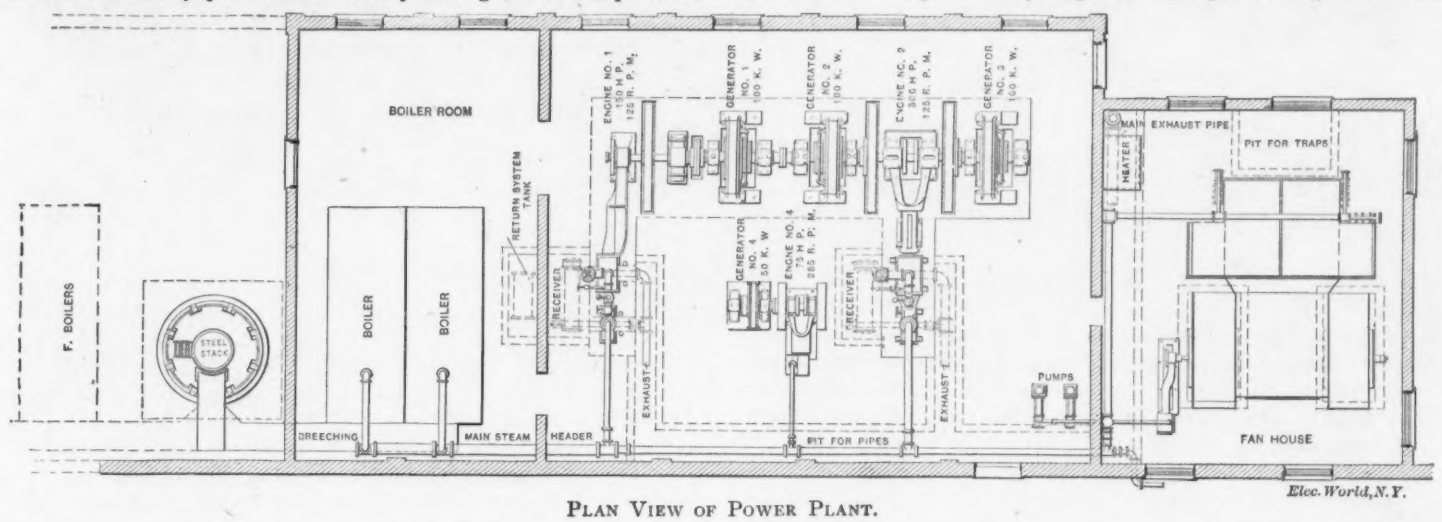
A consideration of these disadvantages led the company to seek a new location with more advantageous conditions. Hammond is practically a suburb of Chicago, being connected to it by an electric road and six lines of steam railways. The belt line makes direct connection with fourteen trunk lines centering in Chicago. A special car leaving Chicago every night delivers small local freight upon the shipping platform of the plant at Hammond every morning. With the same freight rates as formerly, it has been found that the cost and time of handling shipments have been materially reduced in the new location.

The plant is located on a stretch of rolling prairie land, and the building covers about four acres of ground space. It is 520 by 450 feet in size, and consists of but one floor, which makes it possible to pay especial attention to the lighting, and, as a result, the whole roof resembles a vast skylight. The windows of the roof are glazed with frosted glass, and are placed at an angle looking toward the north. Owing to the angle of the roof the direct rays of the sun are kept out of the building, which is thus lighted by the soft reflected rays from the northern sky. It would be hard to conceive of a more evenly or more thoroughly lighted factory building.

The arrangement of the power plant is shown below. The boilers are of the horizontal water-tube type, with 3472 square feet of heating surface and 60 square feet of grate surface per boiler. At the present time two boilers are installed, and the stack is situated so as eventually to be flanked on either side by two boilers of the completed battery of four. The breeching from the boilers to the stack is of sheet steel.

The stack is a self-supporting steel chimney 125 feet high and 54 inches in diameter inside the gas flue. A unique feature of the stack is the method used of inverting each section so that the top end of each section comes outside the section immediately above it. This prevents the soot washing through the joints and down the outside of the stack, as is too frequently the case with steel chimneys.

The engine, shown upon the left end of the row of generating machinery, is an 11½-inch and 18-inch by 30-inch tandem-compound non-densing Corliss engine, and runs at 125 r. p. m. This speed is rather high for a Corliss engine, but indicates the tendency of modern practice where the engine is directly connected to a generator. When properly designed there seems to be little reason why an engine with releasing valves should not be run at this speed, and if successful at this number of r. p. m. we probably will not be satisfied until the speed is again raised. As long as the cost of electric generators of a given size increases in proportion as their speed is decreased there will be greater pressure brought to bear upon engine builders to produce a successful engine of the Corliss or similar type running faster than the ordinary 80 to 100 r. p. m. For power plants of this character the Corliss type of engine, in the minds of a great many engineers and purchasers, has advantages of economy in steam consumption and low cost of maintenance which engines of the high-speed type do not possess. The objection when directly connected to a generator is the cost of the unit.



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PLAN VIEW OF POWER PLANT.

This engine is fitted with double eccentrics and governors on both cylinders, the governor being of the Porter type. The special design of the double-ported admission valves permits a quick cut-off, while the operation of the steam and exhaust valves by separate eccentrics gives the engine a long range of cut-off and large reserve capacity for overloads.

With 120 pounds initial steam pressure and a back pressure of three pounds the engine is rated at 160 indicated horse-power, and is guaranteed to develop each indicated horse-power hour on a consumption of 21 pounds of steam. It has an economical range of power between 100 indicated horse-power and 225 indicated horse-power, but is designed in all its parts to operate continuously on an overload of 100 per cent., or at 320 indicated horse-power. Pro-

vision has been made in the piping to carry this overload by admitting high-pressure steam to the low-pressure cylinder.

The generators are compound wound, and are designed to deliver 100 kw output at 225 volts when running at 125 r. p. m. The field frame is split through the centre in a horizontal plane, so that the upper part can be removed. This operation will not be necessary, however, in case repairs are required on the armature windings or field coils, as provision has been made to slide the entire armature frame parallel to the shaft, along cast-iron footings, a sufficient distance to clear the armature.

The arrangement of machinery in the power plant is shown on page 499. It will be seen that this plan calls for two engines and three generators. The second engine is also a tandem-compound, non-condensing engine, but is of the centre-crank type, with overhanging flywheels. This engine is of twice the horse-power of the side-crank engine; that is, it can develop sufficient power to operate economically two of the 100-kw generators, though when necessary it will be able to operate all three of the generators.

The whole line of machinery is connected on the "Arnold system" of power-station construction. In this system each generator armature is mounted in such a way as to be perfectly independent of the remaining machinery, and by means of a suitable coupling can be put in operation or thrown out of service at will. The shaft upon which each generator armature is mounted is made hollow, so as to allow a solid shaft to be carried through it. This solid shaft is supported in two independent bearings near its middle and extends from engine to engine, but under normal operating conditions it is independent of the engines and of the generator shafts and lies idle in its bearings. Each end of this shaft is provided with a suitable coupling, so that it can be operated by either engine or by both working in unison. The result of this ingenious arrangement of shaft, hollow quills, bearings and couplings, is that each generator can be operated by more than one engine. In a plant arranged with direct-coupled units this feature is a decided additional advantage, for the units can be operated in much the same maner as in a belted plant. Ordinarily in a direct-coupled plant the crippling of a generator will shut down its driving engine, or if an engine breaks down its generator must necessarily be taken out of service.

The method which has been adopted to provide for an increasing demand for power in this plant may prove of interest. At the present time engine No. 1 and generator No. 1 have been installed and are now handling the load. A smaller 50-kw high-speed unit is being placed in position for the purpose of carrying the load when the press-room is working all night. It may also be used to furnish current for the lighting circuits when the combined power and lighting load becomes too large for the Corliss engine and 100-kw unit. Eventually, as the load is increased in size, engine No. 2 and the two additional generators will be installed, and the plant will then be ready to furnish economically all demands for power over a range of from 75 to 525 horse-power. It will be capable of handling a load of 400 horse-power, with a reserve unit for operation in case of accident. The provision for admitting high-pressure steam into the low-pressure cylinder and the capability of the engine for standing an overload have already been mentioned. By taking advantage of these arrangements the smaller Corliss engine can be made to carry double its rated horse-power and take the load of the larger engine.

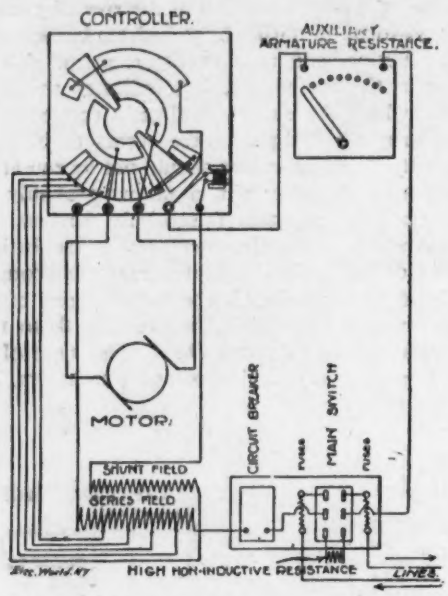
The engine and generator foundation consists of a solid monolith of concrete 8 feet deep and of sufficient width to give ample footing for the machinery. Water-tight iron pipes run through this foundation and under the cement floor of the engine-room to the back of the switchboard for the purpose of carrying the generator leads. These leads consist of stranded rubber-covered and braided lead-encased cables of 600,000 circular mils cross-sectional area.

The switchboard is of highly polished black enameled slate, 1½ inches in thickness, with the usual indicating and regulating instruments. Separate omnibus bars are provided for the power circuits and the lighting circuits. Each generator is furnished with two main switches, by means of which it may be operated on either the light or the power circuits, or upon both at the same time.

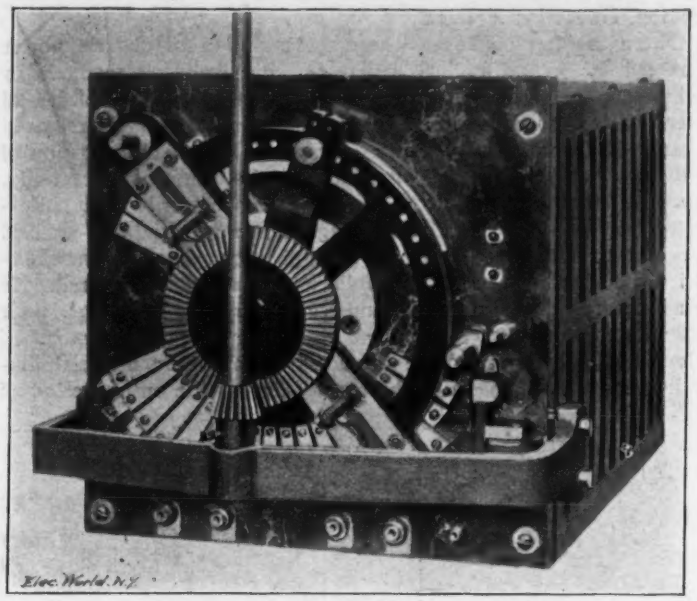
Each feeder leaving the board passes through a fuse, the cut-outs being fastened in a row upon a special fuse block at the top and back of the board. From this block the feeders pass directly through the wall of the engine room into the factory. The power and lighting distributing systems throughout the plant are independent of each other. In the factory two main distributing centres are located in central positions. These centres consist of small switchboards fastened to the wall and surrounded with a hardwood asbestos-lined cabinet. The main feeders are carried on the under side of the iron roof truss on porcelain insulators fastened to iron beams, which are firmly bolted up against the angle iron of the roof. The distributing circuits are carried upon porcelain insulators attached directly to the under side of the wooden roof beams and above the iron trusses. All the feeders and mains are thus installed in the "open-work" style of construction. A workmanlike job has been done, however, and the wiring presents a very neat appearance.

The leads to the various motors and the wires to the arc lamps and switches are carried in iron-armored insulating conduit. In the case of a press motor, for instance, a porcelain cut-out in a suitable box is placed at the top of an iron column 12 feet from the floor. From the bottom of this cut-out box a single run of conduit is led down the side of the column, and thence along a groove in the floor to the motor. All the wiring about the presses, between the main switch, the controller, and the motor, is carried in iron conduit in such a way as to be thoroughly protected from mechanical injury.

The lighting of the plant is accomplished by means of constant-potential enclosed arc lamps. Experience has shown that a very satisfactory illumination can be obtained by hanging a lamp in the middle of each bay and from every other roof truss. This makes each



Controller Connections.



One of the Motor Controllers.

lamp supply light to a floor space 29 x 32 feet. Where better illumination is required for any special work, incandescent drop lights are placed, and, sometimes, as upon the presses, portable incandescent lamps with an allowance of cord are provided for work requiring occasionally a temporary light.

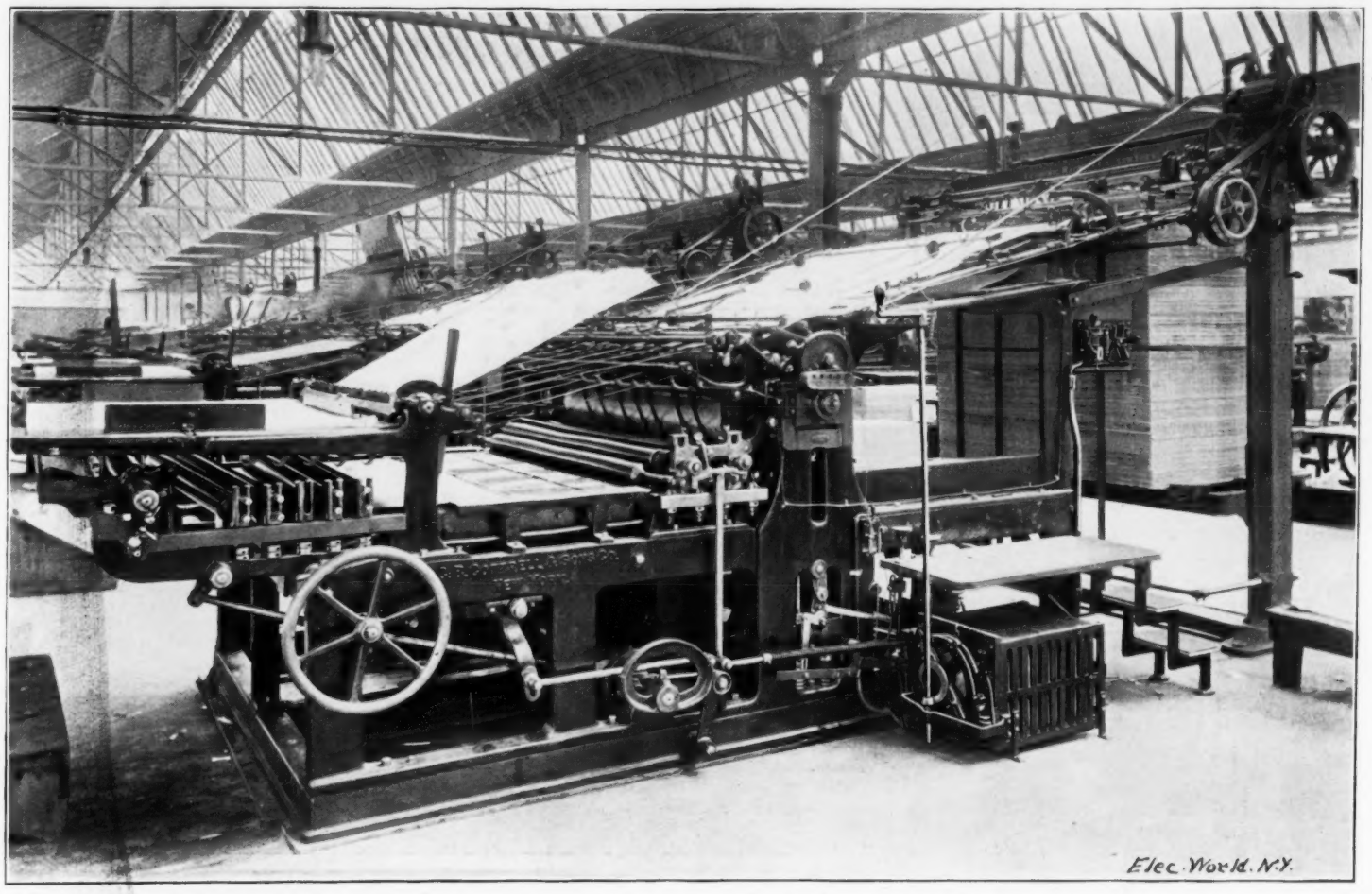
The arc lamps are controlled by double-pole, 220-volt snap switches carried on slate bases, securely attached to the side of the iron columns. The wiring to and from the switches and to the arc lamps is run in iron-armored conduit fastened to the columns and to the under side of the roof trusses. At every lamp opening the conduit contains a tee branching down, and to this tee is screwed a short nipple carrying a hook upon which the lamp is hung. By this method of installation the wires are entirely concealed. Each set of four lamps is protected by a cut-out placed in a manner similar to the ones protecting the motor leads.

There are installed in the plant at the present time a total of 95 motors, with a total of 321 horse-power.

The motors throughout are of the Lundell type, those directly attached to the presses being multipolar, with a relatively large diameter. The commutator, like the armature, is short and of large diameter, with a large number of bars.

There are various considerations which usually determine in each case whether a motor should be belted, geared or directly coupled to a machine, or perhaps indicate that the machine should be grouped with others of its class and driven from a common shaft. For instance, there are certain classes of machinery, such as folders, stitchers, type-setting and type-distributing machines, etc., which take but a very small amount of power, which are each in operation almost continuously and which can be arranged in rows convenient to a line-shaft. There are few, if any, advantages to be gained by driving such machines with individual motors, and especially is this the case when the driving shaft can be placed below the floor, as is done in the plant under consideration. The machine belts pass directly down through the floor to pulleys carried upon a shaft supported by floor stands bolted to planks in the bottom of the shaft pit. This pit is built with a concrete bottom and brick side walls, and is covered with the floor built in sections, so that it can be removed for purposes of inspection and oiling. The shaft is driven by a belted motor set upon a stand at the wall end. This motor rack is made of three by three timber, securely bolted together, and fastened to the floor. Underneath the motor and between the legs of the rack is placed the starting box, mounted on a slate base, which also contains the main-line switch and the fuses for the protection of the motor. Each box is also provided with an overload attachment which will break the circuit in case of an excessive current. As a rule the motors belted to a line-shaft in this way are shunt wound and run at a speed of 1000 r. p. m.

It may seem strange, in view of the admitted losses in line shafting, that any shafting whatever was allowed in the plant, but when the inefficiency of very small motors and their comparatively large cost of installation are considered, reasons will not be found lacking for putting a limit on the tendency toward individual machine driving. In some cases, such as paper cutters, smashers or embossing machines, which depend largely upon the inertia of their moving parts to furnish the power for their operation, a great advantage is gained by having a number belted to a line-shaft, and thus operated by a common source of power, for, under such conditions, each machine gets the benefit of the stored momentum of the fly-wheels of the entire line. A case in point is that of six cutters and a book-binding machine operated by one 5-hp motor. Individual driving would have required at least seven 1-hp motors, and the result would have been far from satisfactory or economical. On the other hand, there are machines which may take a small amount of power, but which are in operation only intermittently, or perhaps cannot be conveniently located in positions to be belted to a line-shaft. Such instances are found in the electrotype foundry, where there are numerous small machines, each with its individual motor either belted or attached by gearing.



VIEW OF PRESS-ROOM, SHOWING SKYLIGHT UNOBSTRUCTED BY BELTING OR SHAFTING. MOTOR-DRIVEN PRESS IN FOREGROUND.

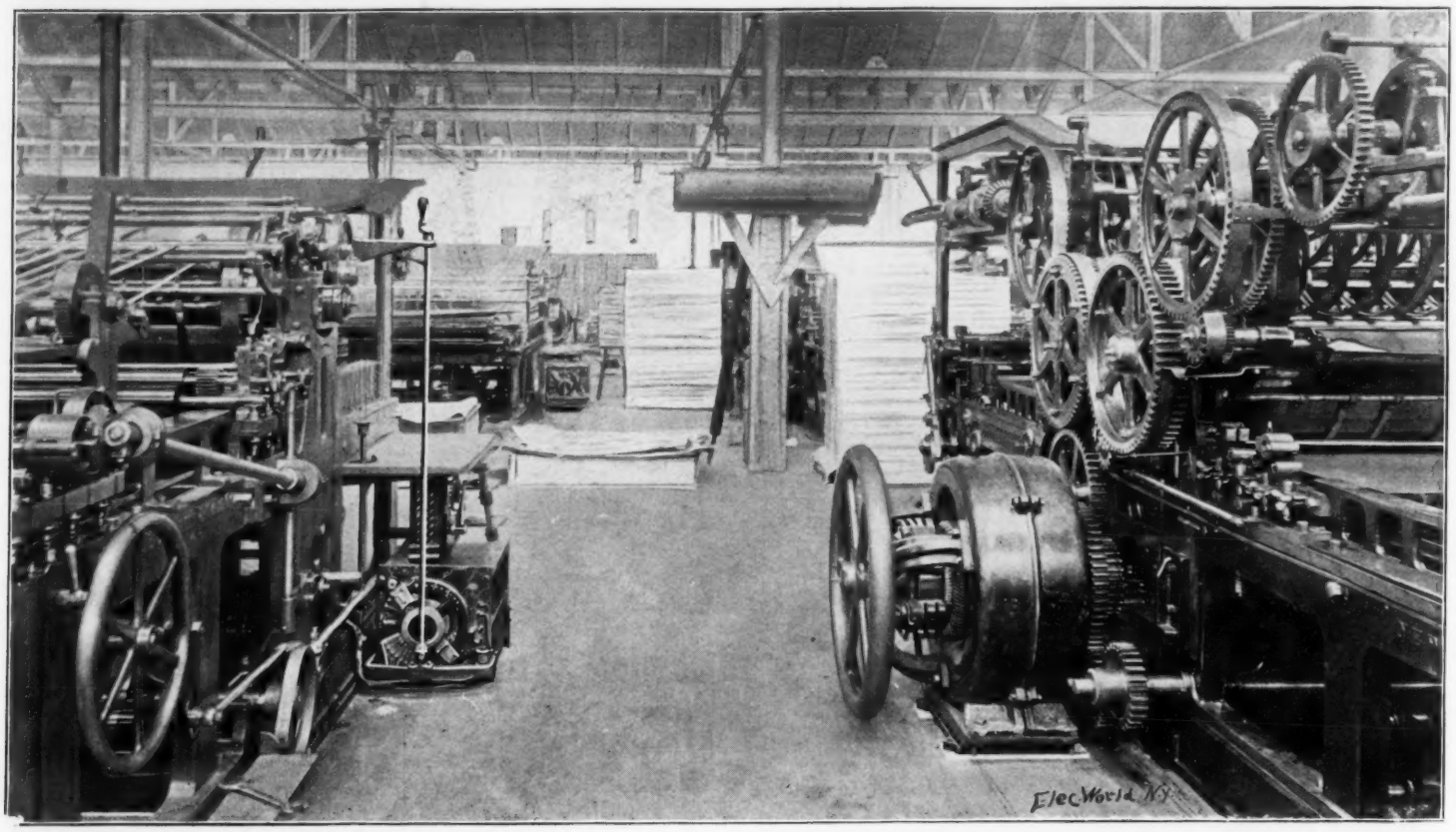
The driving of the large presses, however, presents the most problems. Here the conditions of operation leave but little doubt that individual motors should be provided. But whether to belt, gear or direct couple the motor to the press is the problem. The belted equipment is the cheapest, the easiest to buy and install, and the more convenient to repair, as an injured motor can be quickly replaced. The higher speed at which they run furnishes a certain amount of inertia to carry the press over the "centres" of each impression. The belted motor takes up valuable room, however, and as it must be protected it usually presents an unsightly appearance. The geared motor can be installed in most cases and is an improvement over the belted type, though the increased cost of its installa-

tion makes its advantage a doubtful one. The direct-coupled motor takes the place occupied by the driving pulleys of a belt-driven press, and thus has the advantages of neatness and compactness. As presses are usually built, the main driving shaft makes five revolutions to every impression, so that a press operating at 1440 impressions per hour requires a direct-coupled motor running at 120 r. p. m. This slow speed means a large and comparatively expensive motor. Its armature must be keyed directly to the press shaft, and this often means that the shaft of the old press must be taken out to have an extension welded upon it. The slow speed of the armature prevents the accumulation of energy to help the press over the centres. In spite of these disadvantages, however, the improvement in the mechanical design of the equipment with direct-coupled motors over the belted or geared arrangements and the longer life of the slower-running motors were thought to be sufficient to justify the extra investment, and, therefore, motors directly coupled to the forty-eight presses were installed.

The control of the press motors presents a number of difficulties, and the solution which has been worked out in this case may prove of interest. A printing-press controller should have a handle placed within easy reach of the feeder, by means of which the press can be conveniently started and stopped. In case of a failure of the current from any cause, the controller should be automatically released so as to return to the "off" position. It should have a locking attachment so that the pressroom foreman can adjust the press for a certain number of impressions per hour, and then leave its operation to the feeder. This locking device should not interfere with the stopping or starting of the press, but should insure that while the press is in operation it will be running at the predetermined speed. With ordinary electric press controllers the convenience with which the feeder can change the speed of his motor is a temptation to "soldier" when not working directly under the eye of the foreman. The controller should provide for at least two back-up speeds, and should have a handle on the side of the press opposite the feeder, by means of which the press can be run slowly in either direction in "make-ready" operations.

The most important requirement, however, is to secure a wide range of speeds for the press. For instance, it is sometimes desirable to be able to operate a press at a number of speeds ranging between 1000 and 2000 impressions per hour. This means that the motor should be controlled between 84 and 168 r. p. m., or that its lowest speed should be 50 per cent. of its highest speed. Now, the speed of a short-wound motor may be varied in three different ways: (1) resistance may be inserted in series with the armature, (2) the intensity of the field magnetism may be changed, or (3) the potential difference applied to the motor may be altered. The first method is uneconomical and unsatisfactory in operation, as it results in an unsteady speed under such a variable load as is given on a printing press. The second method, while more economical than the first, is limited in its application, for the speed of a motor cannot be satisfactorily controlled in this manner below the limit of about three-quarters of its full speed. To extend this range of speed and insure sparkless operation at the higher loads when the field is weakened a large and expensive motor will be required. The third method requires complicated generating machinery and distributing circuits, and if but two voltages are used (one double the other) the system will not secure the range of speed desired.

The system of control adopted for this plant combines the first two methods. Between full speed and 75 per cent. of full speed the speed variations are secured by changing the field magnetism. This is accomplished by cutting in or out sections of the series field winding. Between three-quarters speed and one-half speed the various steps are secured by inserting resistance in the armature circuit. Three-quarters speed is taken as the average or normal speed of the press, and at this point all series field coils are cut out, and the motor is operated as a straight shunt machine with no resistance in series with its armature. In this way the main controller provides for ten variations in speed, five of which are secured by armature resistance and five by field commutation. An auxiliary resistance box is placed on the motor or adjusting side of the press, by means of which ten additional speeds can be obtained between any two of the main controller speeds, so that this method of control secures 100 different speeds, and it is, therefore, possible to operate the press with a fine adjustment and always at the highest rate which the character of the work will permit.



View of Press-room Showing Motor and Controller of Motor-Driven Presses.

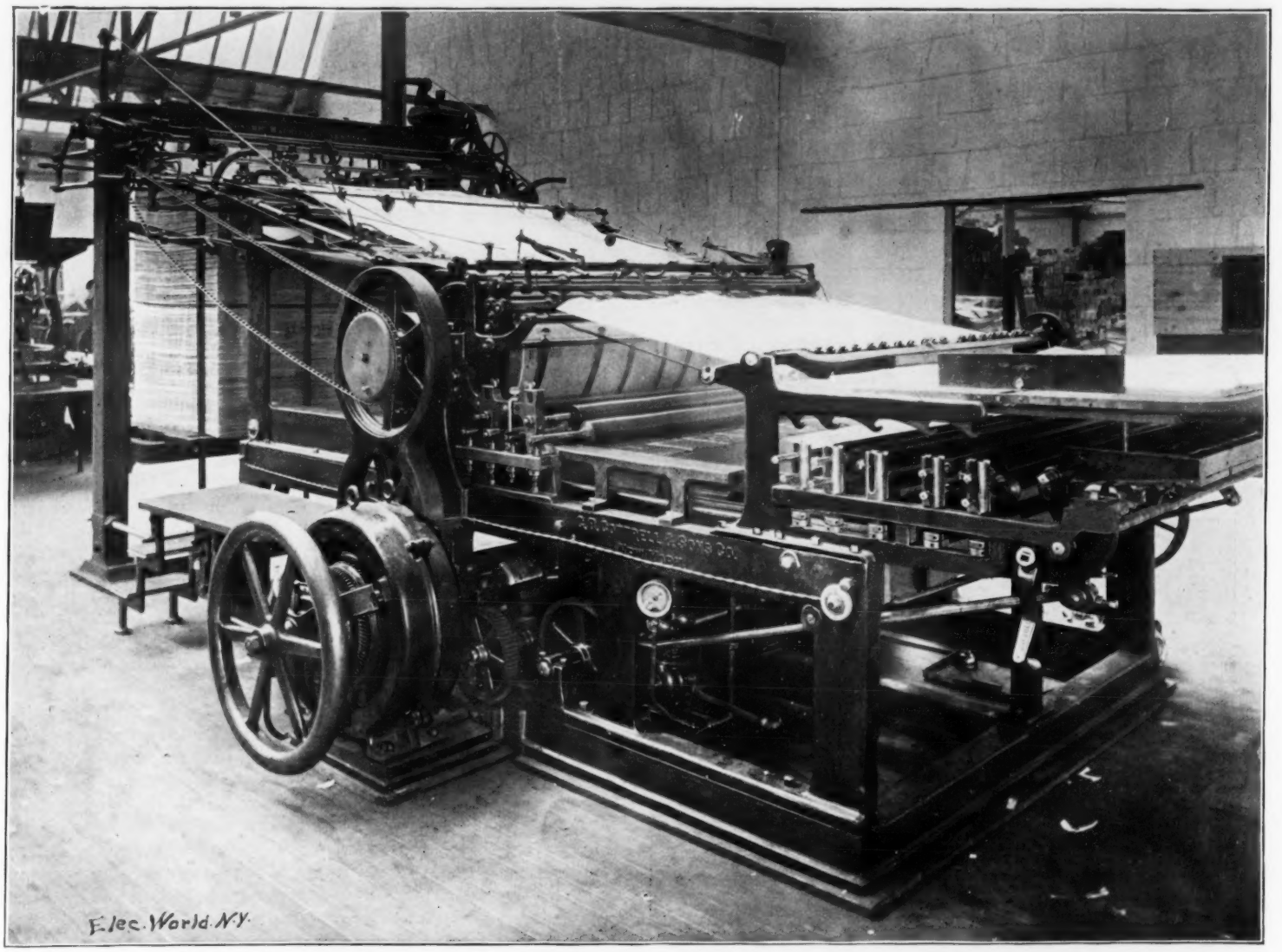
The diagram of the controller connections is shown on page 500, as well as the construction of the main controller. The steel rod passing down from the handle at the left of the press feeder, Fig. 3, operates the contact arms by means of a bevel gear. These arms carry carbon brushes, and, passing over the segments, cut in or out armature resistance and series-field windings. The contact arms are held in a semi-circular cast-iron connection which contains a

series of small holes corresponding to the number of speeds secured by the controller. Pivoted at the centre is a movable arm fitted with a handle and pin which can be made to enter any one of the ten holes. When the current is turned on and the controller revolved, this arm moves around until it engages a pawl operated by an electromagnet. As long as the current is passing through the motor this magnet holds the controller in position, but it will release the arm as soon as the current is interrupted, and a strong spiral spring on the controller rod immediately brings the arm back to the "off" point. The "automatic" low-voltage release is thus secured, while the locking feature is obtained by means of the movable arm, which can be set at any hole corresponding to any desired speed. The hole corresponding to the normal speed is marked, and the press is usually operated on this point.

On the right of the feeder is placed a small panel board containing the main-line switch, a circuit breaker and fuses for protecting the motor. The switch is of the "tumbler" type, and is connected so that when thrown up it connects the motor ready for operation. When this switch is opened an extension of each blade makes a contact with the lower clips so as to connect the shunt fields of the motor across a non-inductive resistance, providing a path for the field discharge and thus avoiding the danger of a puncture. The circuit breaker is adjustable through a wide range, and is of the "time limit" type. In this type the acting magnet is shunted by an exposed coil of high-resistance wire. If an excessive current exists for a length of time, the shunted current flowing through this exposed coil heats the wire and thus sends a larger proportion of the current through the magnet windings and the circuit breaker acts. Momentary currents, such as occur upon starting the motor, or when it is loaded heavily for an instant, are not supposed to open the circuit breaker. Unfortunately, the feeder soon discovers that the circuit breaker can be adjusted to such a point that it will bother him only at long intervals, and at this point he leaves it. Practically, then, the motor must be protected by fuses which cannot be adjusted. These fuses are of the enclosed cartridge type and are placed in both sides of the circuit, one being located on either side of the main-line switch upon the panel board. The appearance of the controller and panel board can be seen on the press in the foreground of the picture presented on page 501.

By means of a lever and arm which pass through the bottom part of the press the controller can be operated from the opposite side and the press can be run slowly in either direction in "making ready," without tugging at a belt or without the assistance of the feeder. Push-buttons are located at convenient places about the press frames, with circuits connected so as to shunt the "automatic" magnetic release attachment, and thus the press can be quickly stopped from any one of a number of points in case of accident.

It is needless to point out that such a model printing establishment as has been described would have been impossible with the old method of transmitting power by means of belts and shafting. The successful operation of this plant is such an emphatic argument in favor of the electrical method of operation that it may be well worth while to review briefly the advantages which have been secured.



MOTOR-DRIVEN COTTRELL PRESS WITH AUTOMATIC FEEDER.

The light throughout the plant is entirely unobstructed by belts, so that during the day full benefit is secured of the ideal skylight method of lighting, while at night the operators are not annoyed by shadows, and the amount of artificial illumination required is a minimum.

The predominating idea in the arrangement of the entire plant has been to secure convenience in operation, and the designers of the plant have not been hampered with the necessity of concentrating the machinery near the source of power or of arranging it, in all cases, convenient to long lines of shafting.

The elimination of overhead power-transmitting devices not only takes away the danger of moving belts and revolving pulleys, but improves the appearance of the plant, and this is certainly appreciated by the employees, who take pride in the neat appearance of their workrooms.

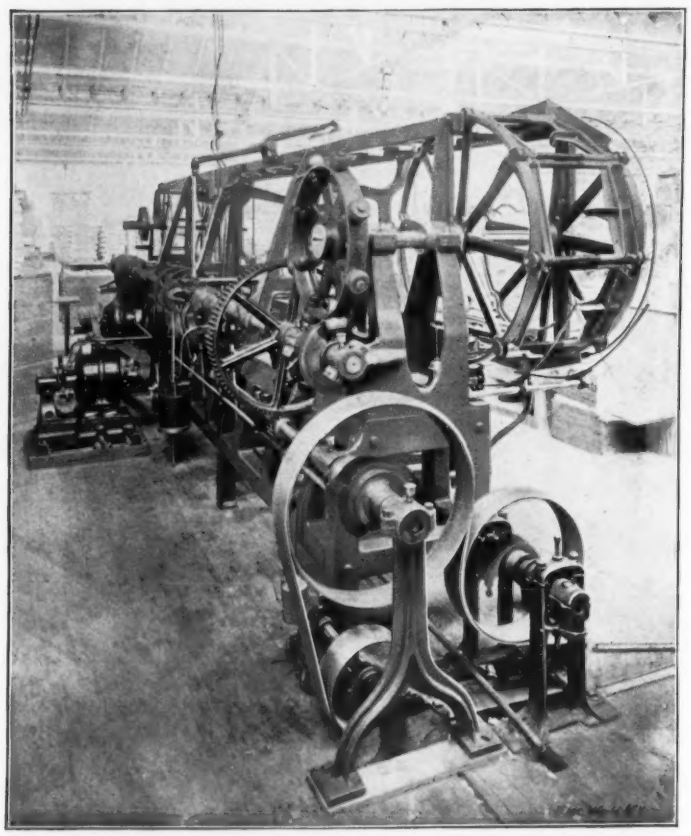
Without overhead belts and pulleys keeping the dust-laden atmosphere in constant agitation, there is much less waste of stock spoiled by dripping oil or falling dirt—an advantage which it takes a printer to appreciate thoroughly.

The arrangement of the plant over a large area instead of in floors one above another, with belts passing from floor to floor, secures lower insurance rates. The wires running from the engine room to the departments when once installed require no further attention. One department may be operated overtime, while the remainder of the plant is at rest. The lighter the load the more efficient become the transmitting circuits, while the opposite is true with belts and pulleys. The number of units in operation in the engine room can be varied to suit the changing demand for power, and thus secure an economy which is impossible with one large engine belted to a main driving shaft.

The absolute control of the presses, with their easy and convenient manipulation, when "making ready," and their wide range of speed, allowing them to be run at their fullest capacity, has a great influence in increasing the output of the plant. When a machine is not in operation it is immediately shut down and there are, therefore, no "stand-by" losses outside of the engine room.

The most important advantage, however, is the saving in fuel. The result of the operation of the new plant is that only about one-third of the amount of coal is burned that was required before the move was made. A part of this saving must be attributed to the design of the power plant, with its modern equipment, so that just how much economy has been gained by the operation of the purely electrical part of the plant cannot be definitely determined.

The Corliss engine was furnished by the Atlas Engine Company; the motors by the Sprague Electric Company; the motor controllers and starting boxes by the Cutler-Hammer Manufacturing Company, and the switchboard and wiring by the Western Electric Company. George C. Nimmons was the architect of the building.

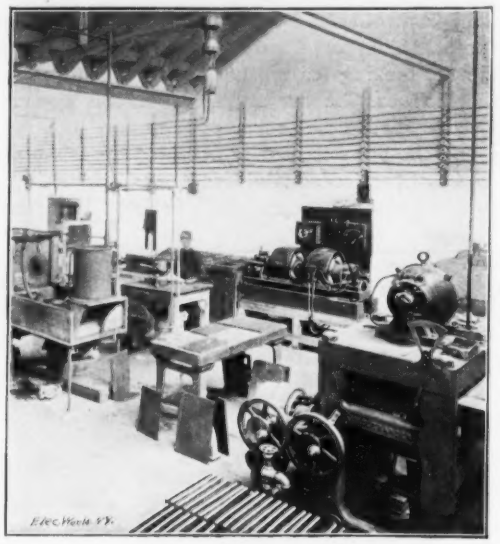


Motor-Driven Book-Covering Machine.

Bion J. Arnold consulting electrical and mechanical engineer, and Thomas Sheehan mechanical superintendent. Much of the success of the enterprise is due to the energetic management of the president of the company, W. B. Conkey.

The Belfast Municipal Electric Plant.

The new Belfast municipal station, although on the boundary of the present area of supply, is very centrally situated as regards Belfast as a whole, and will ultimately become a true central station. It is very conveniently situated on the River Lagan, enabling the condensing plant to be used without difficulty, and facili-



Electrotyping Room, Conkey Printing Plant. Electrotyping Motor-Generator in Background.

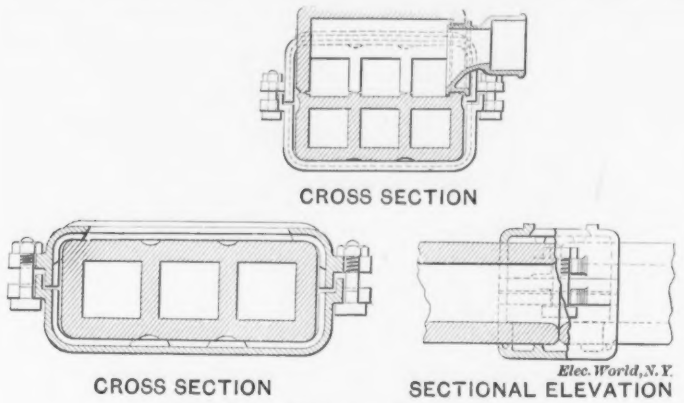
tating supply of fuel and materials. The ultimate capacity of the buildings that can be erected on the land acquired for this station is 20,000 horse-power, but the present buildings are capable of housing only 10,000 horse-power. The following description and illustrations are taken from the London "Electrician."

Owing to the soft and marshy nature of the subsoil at Belfast, the buildings have been erected on piles, no less than 1200 having been driven for the building and 154 for the chimney stack, which is 175 feet in height and has a diameter at the base of 25 feet, the internal diameter of the flue being 13 feet. The buildings throughout are of fireproof construction, the floors being of concrete and steel. The paving of the battery-room floor is of vitrified tiles embedded in cement, the joints being afterward run with pitch, this having been found to serve best for the purposes of a battery room. The ground floor is occupied by the engine house, the boiler house and accessories, the battery room and various offices. The boiler house and engine house are each 200 feet in length, the latter being 64 feet wide and the former 40 feet wide. Both are very spacious, lofty and well lit, the roof in each being carried by light steel trusses. When completely equipped, the present boiler house will contain ten Lancashire boilers, each 30 feet in length by 8 feet diameter, but three only are at present erected and a fourth is being put in. Two of these boilers are fitted with mechanical stokers of the Bennis and Proctor types, and the third is at present arranged for hand-firing. By this arrangement the relative merits of hand-firing and the various systems of mechanical stoking can be carefully watched by the chief engineer, and the decision ultimately arrived at as to which is the best adapted to local conditions. Welsh small coal is usually burned.

At the end of the boiler room there is a large economizer, consisting of 216 tubes, the scrapers of which are worked by a small electric motor. The coal bunkers extend the length of the boiler house, and are arranged so that they can be worked with helical conveyors and elevators for feeding the mechanical stoker hoppers. At present these hoppers are filled by hand. The pump room adjoins the boiler house, and is extremely well arranged. It is equipped with steam and direct-geared, motor-driven pumps, arranged on a duplicate feed-water system, the pipes being so designed that the feed can take place either through the economizer or direct to the boilers. Each boiler, which works at 180 pounds pressure and has been tested to 270 pounds, feeds steam into a duplicate system of steam mains, carried by tie rods from brackets fixed in the walls or suspended from the roof. The connection to each engine consists of a Y-piece provided with stop valves, and the boilers have two junction valves with a 5-inch branch to each main. The piping is of lap-welded mild steel, the flanges of wrought steel

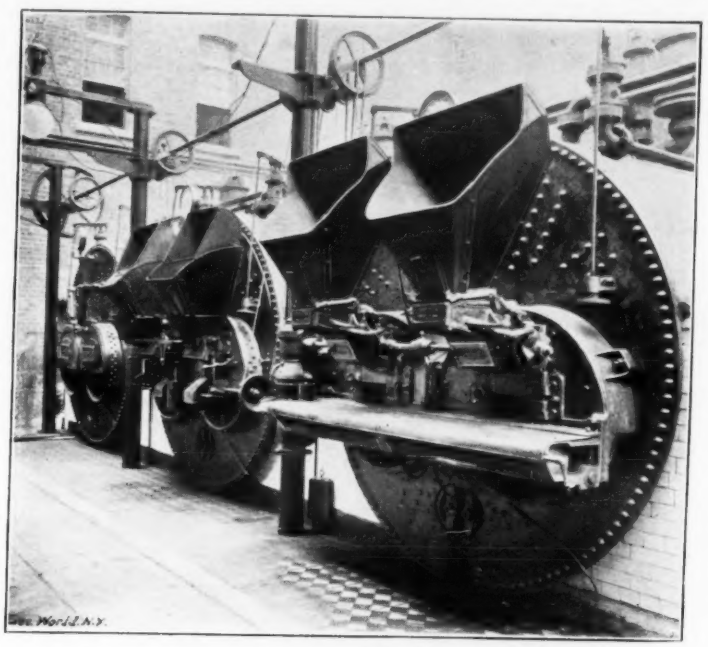
being welded on. Copper expansion bends are provided to allow for changes in length. Each boiler has three safety valves, and the valve equipment throughout is on the Hopkinson-patent parallel principle.

The present equipment of the engine house consists of three sets



SECTION OF DOULTON CONDUITS.

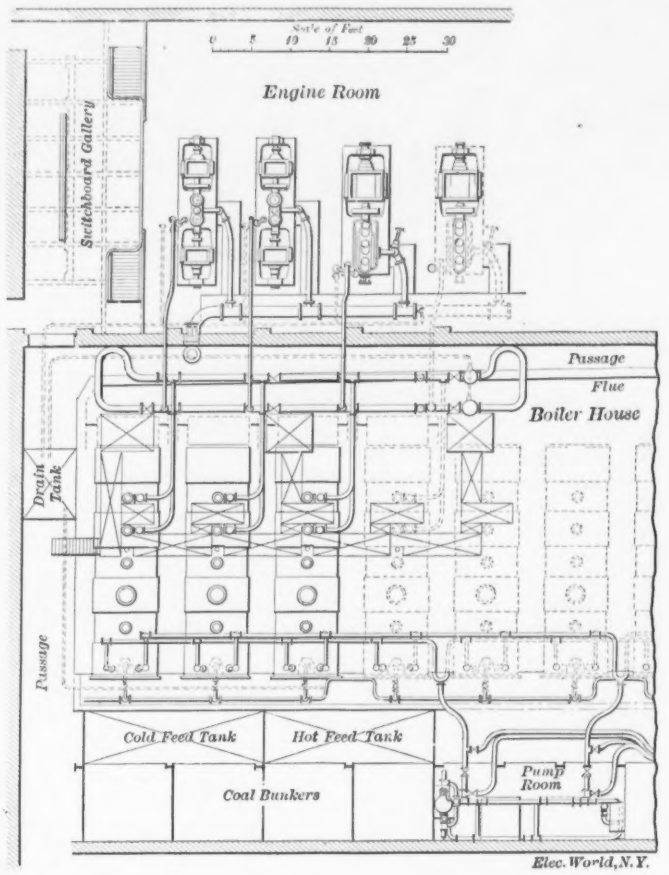
of continuous-current steam dynamos, the steam engines being built by Messrs. Belliss & Co. and the dynamos by Messrs. Thomas Parker (Limited). A fourth set is in course of erection.



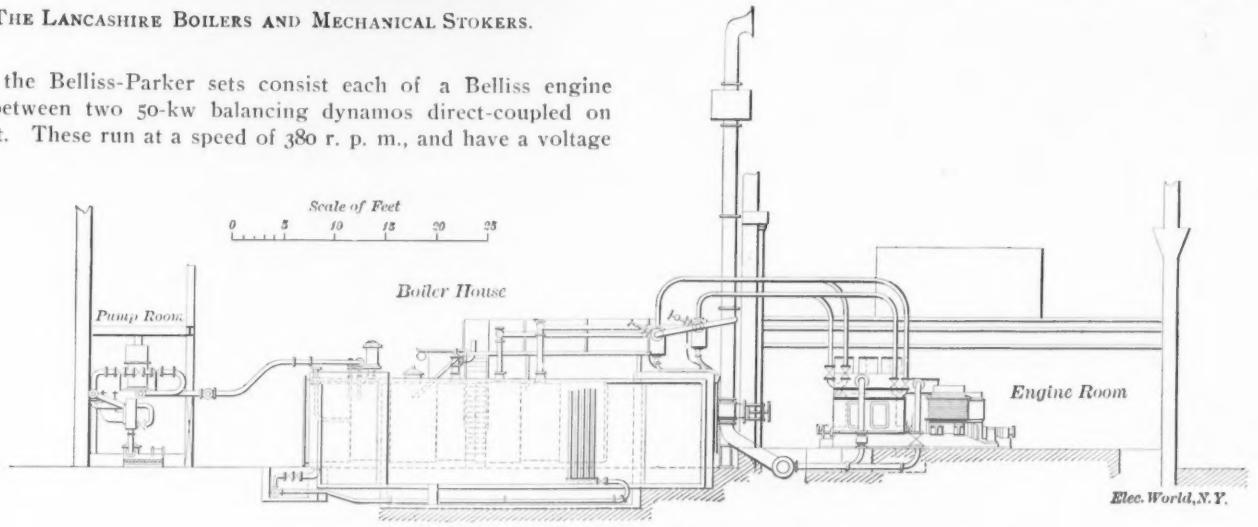
THE LANCASHIRE BOILERS AND MECHANICAL STOKERS.

Two of the Belliss-Parker sets consist each of a Belliss engine placed between two 50-kw balancing dynamos direct-coupled on one shaft. These run at a speed of 380 r. p. m., and have a voltage variable from 220 to 350 volts. The larger set consists of a single three-crank engine, coupled direct to a 200-kw continuous-current dynamo, capable of delivering from 440 to 500 volts. When worked at the higher pressure of 500 volts these generators might conveniently be used for driving electric tramways on the trolley system, but at present there is no definite scheme of electric traction in Belfast.

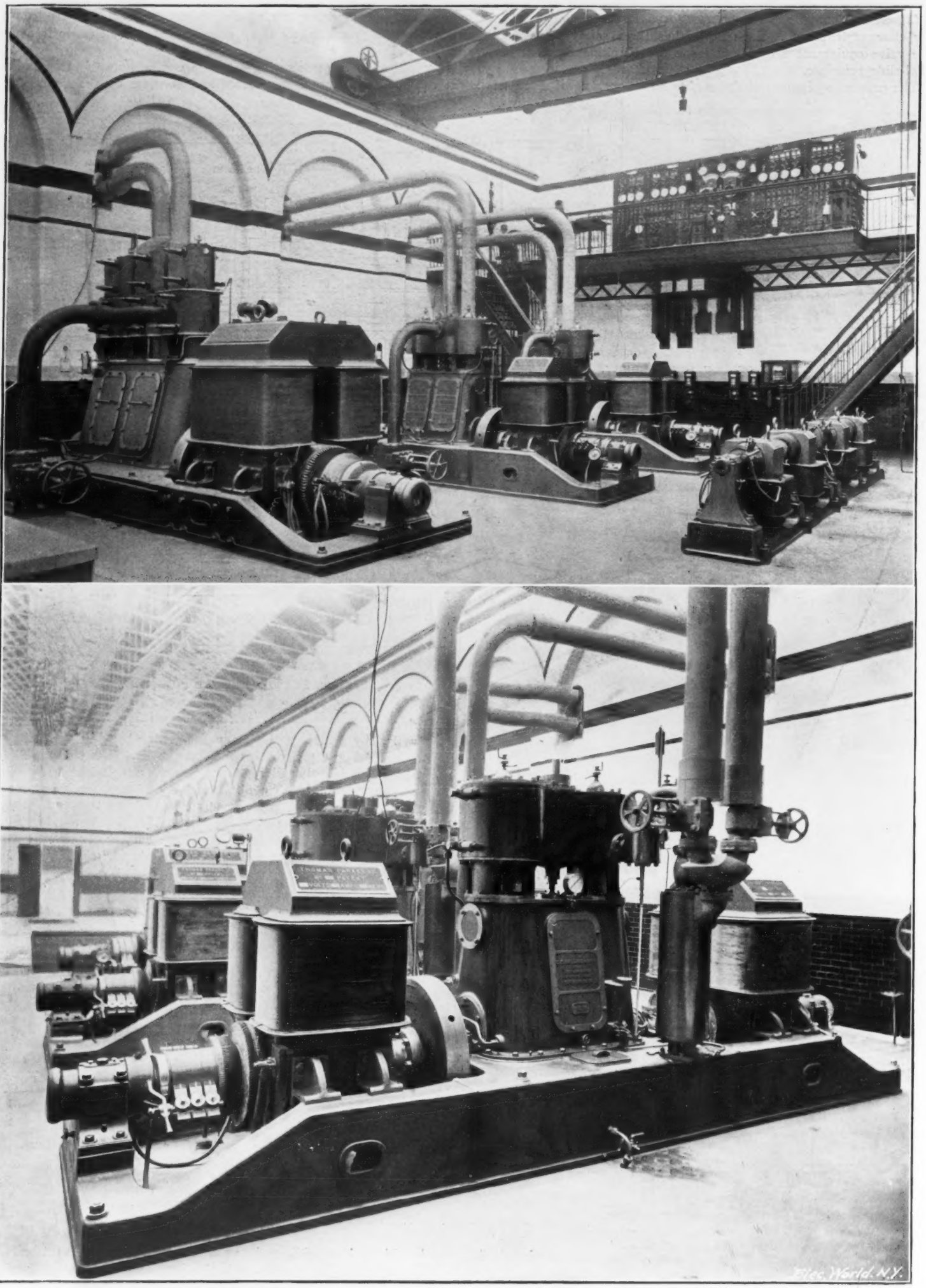
In addition to the generating sets the engine house is at present equipped with motor generators and boosters on the Crompton principle, these being used either for balancing on the three-wire mains by boosting the feeders, or for charging the cells. At one end of the machine room there is a spacious and well-equipped switchboard gallery, from which a splendid view of the machinery room can be obtained. The board is at present equipped for six feeders, eight generators, and the boosters, motors, generators and three-wire batteries. The panels are of enameled slate, 7 feet 6 inches high, the width varying from 2 feet 8 inches to 3 feet 3 inches. The framework of the switchboard is of steel, with teak mouldings between the panels. A novel feature of the switching arrangements is the introduction of mechanical gear in place of electrically connecting the wires for the regulating resistances. A similar method of control is in use for the regula-



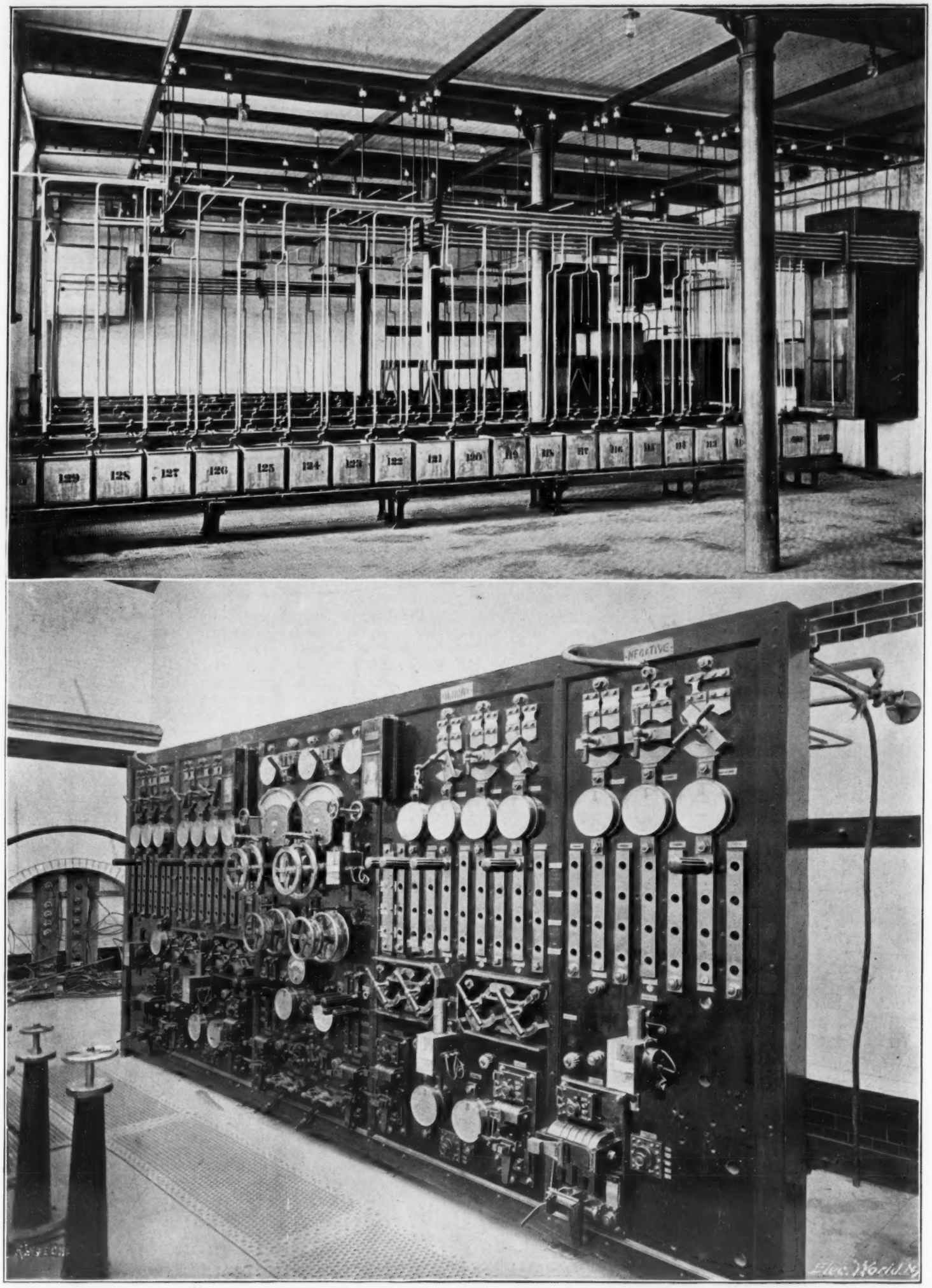
PARTIAL PLAN OF BELFAST POWER PLANT.



SECTIONAL ELEVATION OF BELFAST PLANT.



450-Volt Generating Units, Motor Generators and Boosters.
Main Generators, with Three-Wire Set in Foreground.

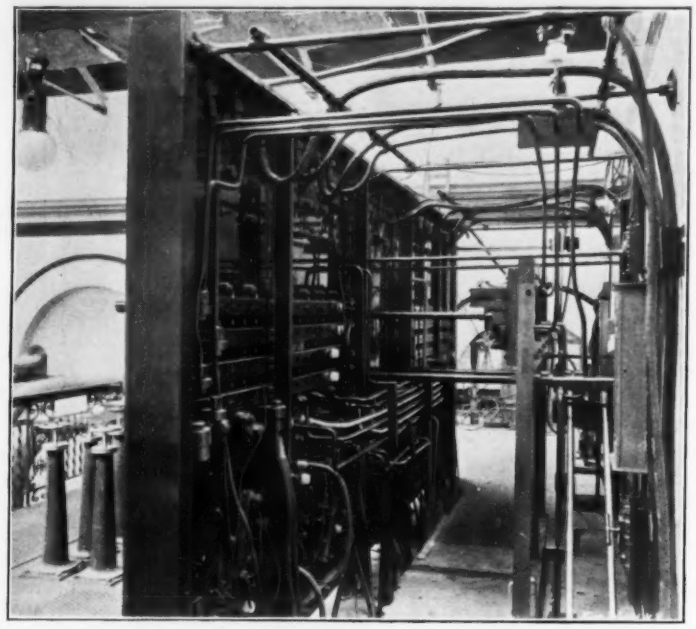


THE STORAGE BATTERY ROOM.
THE FRONT OF THE SWITCHBOARD.

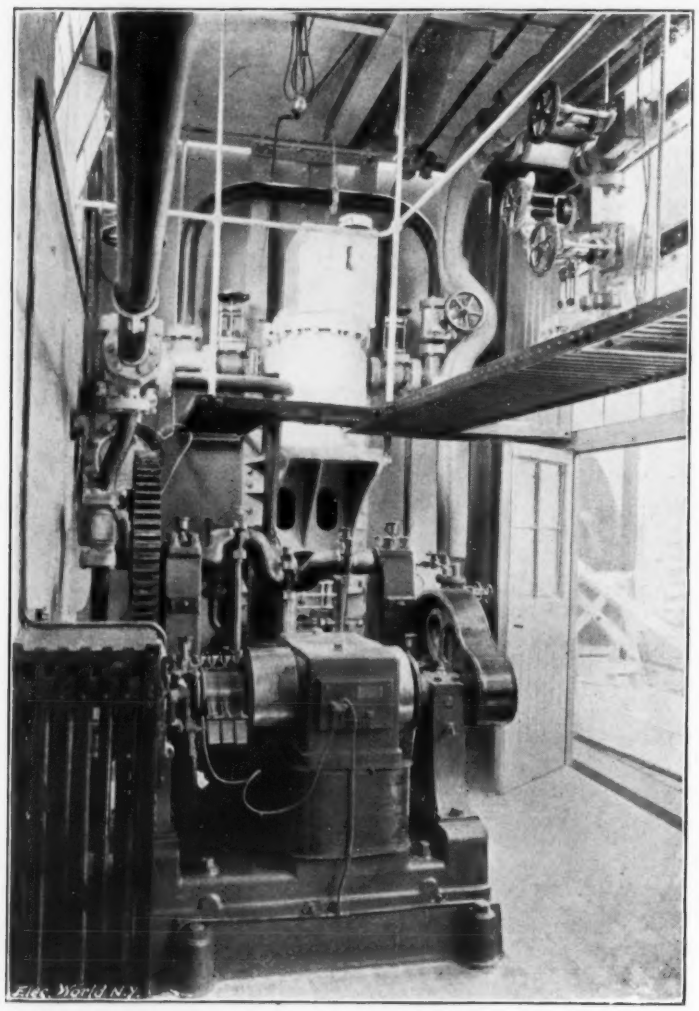
tor end-cells of the battery, for the purpose of regulating the battery pressure in charging and discharging.

The battery room is on the lower level immediately behind the switchboard, and controlling shafts, operated from the switchboard, pass down through the floor to the regulating switch on the battery room wall. The battery room is at present only equipped with one-half of its possible storage capacity—viz., with two batteries each of 130 E. P. S. cells of the Faure-King type. The normal capacity of these cells is 500 ampere hours for five hours, but they are capable of developing 300 amperes for one hour's discharge. Overhead, throughout the battery room, are a number of movable contact connectors, by means of which any cell may be milked from the hospital cells. The electrical connections for this operation are clearly shown in the illustrations. The ingenious but apparently impracticable system of telescoping the electrical connections of the batteries for the purposes of regulation has been abandoned. This method was introduced by Professor Kennedy into the old station, but it has been found that the irregularity of charging and discharging the overlapping cells is more marked in such an arrangement than with the ordinary end connector contacts. At present there are forty-five end-cells on each battery, these being, in each case, at the middle wire or inner end of the battery. Thus, ninety cells in series are regulator cells, and these may be charged up independently of the other cells in the battery by means of a local circuit, the current coming from one of the motor-generators running at a low pressure. While the two main batteries, therefore, are working on the feeders or general supply, the out-of-use regulator cells may be charged up to their proper limit. This arrangement is found to work much more smoothly and satisfactorily than the telescope system.

Distribution from the new station is on the three-wire continuous-current low-pressure system, which has been selected with a view to the combined working of the two stations over an extended area. In the early days of electric lighting a certain amount of bare strip was laid down, but owing to the marshy nature of the Belfast soil this has not proved successful, and no more strip has been put in. There are short lengths of lead-covered, armored three-core cable, but the cables, as a rule, are of single core, the feeders varying from 0.2 to 0.525 square inch section, the mains being 0.2 square inch on the outers and 0.1 square inch on the middle conductor, excepting on very long lines, where 0.2 square inch section middle conductor is put in. Of main cables, no less than 30,000 feet of roadway frontage have been put in, and there are in all some 250,000 feet of single duct. Practically the whole of the drawn-in cable is carried in Doulton conduits of the standard type, with either two, three or six rectangular ducts, each 2¼ inches square. On account of the softness of the soil in which these are laid the joints have had to be specially strengthened by means of a locked cover and chair specially designed for the purpose, this being of cast iron pieces clamped together and bolted in position. The interior of the joining pieces is recessed, and the upper piece is provided with an aperture through which is poured a rapid-setting bituminous compound, which entirely surrounds the ends, but is prevented from entering the ducts by mandrils, one of which is inserted into each duct while the joint is being made. Thus perfect continuity is secured throughout the duct, while the bolted covers and chair give ample rigidity to the conduit to enable it to withstand a subsidence of the soil. Branch coupling connections are provided for in the following manner: At suitable intervals in the line of conduits special lengths are laid which are grooved during manufacture in such a way that, while strength is preserved, a longitudinal division can be made by means of a chisel when desired. When a T-connection is required the upper portion of the split length is detached, giving access to the cables. The cable joints having been completed, a junction cover, made for the purpose, is substituted for the piece which has been detached. This cover is fitted with a cast iron socket-piece to take the service pipe. Details of the service box, as applied to a six-way conduit, are shown in an accompanying illustration. It may be interesting to state that the most distant point at present supplied with current is 2¼ miles from the new generating station.



Rear View of the Switchboard.



Interior of Pump Room.

Dating from July 1 last the charges for lighting were the equivalent of 14 cents per hour for the first one and one-half hours' average total used on the consumers' maximum demand, and 4 cents per kw hour afterward. A special price of 10 cents per kw hour is made for churches and other places of worship. For power and heating purposes, the charges are 8 cents per kw hour for the first one and one-half hours, and 3½ cents per kw hour afterward. Mr. McCowen has devised a very serviceable and effective system of hiring out motors, the motors being actually supplied by the electricity department. The charges for this service range from an annual rental of $12.30 for a ½-hp motor to $60 for a 10-hp motor. Meter rentals range from 60 cents per quarter for 10 amperes up to $3.60 per quarter for 500 amperes.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

COMMUTATOR DESIGN. Matthews. Lond. "Elec. Rev.," Oct. 21.—An article on commutator design, in which he enumerates and discusses six causes of sparking, with special reference to the last three, which are: Faulty construction of the commutator, bad connections and too small a commutator. He enumerates the conditions of a sound commutator, referring chiefly to the mechanical construction; he claims that in all commutators the method of holding the various segments together is far from being a sound mechanical construction; fibre washers at the ends of the commutator are the worst materials possible; he claims that the only proper material is pressed mica and micanite.

POLYPHASE MOTORS. Hanappe. "L'Eclairage Elec.," Oct. 15.—A continuation of his long article, in which he studies the action of such motors in detail. The article does not admit of being abstracted.

Lights and Lighting.

NERNST INCANDESCENT LAMP.—"Zeit. f. Elektrochemie," Oct. 20.—A brief description of a device of Deri for producing the heat which is necessary in the Nernst non-conducting filament, in order to make it a conductor. The Nernst filament consists of a body which, when cold, is a non-conductor, but which after being heated becomes a conductor. He accomplishes this by means of a filament inside of the other, whose resistance is so high that a current passing through it will generate sufficient heat to warm up the body surrounding it to the necessary temperature. This inner filament is made of a mixture of a refractory, non-conducting material or of a conductor of the second class, with metal or graphite, the materials being finely pulverized and intimately mixed; the material is made plastic and then pressed into rods and filaments. Nothing is said of practical tests.

NON-INTERCHANGEABLE LAMP SOCKETS.—"L'Energie Elec.," Oct. 1.—A brief, illustrated description of a lamp socket made in France, the object of which is to prevent a consumer, who pays according to the number of lamps installed, from taking out a lamp and replacing it by one of a higher candle power. The socket is made on the principle of a bayonet joint, but there are three pins and corresponding slots, the relative distances between them being different in lamps of different candle power, thus preventing a lamp from being inserted in a socket made for another one; the sockets are made for 5, 10, 16 and 32 cp lamps.

FIRE-FLY LIGHT. Broomall. "Sc. Am.," Nov. 5.—A short article giving a summary of what is known on this subject. This light contains photographic rays, which will pass through aluminum, cardboard or copper plate; the rays are capable of reflection and probably refraction and polarization; this indicates the presence of rays belonging to the ultra-violet class, and if this is so they are probably the same as the rays emitted by uranium, known as Becquerel rays; besides these invisible photographic rays it contains ordinary light rays. The organ producing them consists of a pale, transparent, superficial layer which gives off the light, and a deep opaque layer whose function is not obvious; the ultimate branches of the tracheæ or air tubes are distributed through this apparatus, as are also nerve fibres. Carbonic acid extinguishes the light and oxygen intensifies it, which points strongly to the theory that the light is the result of some form of slow combustion, and the probabilities indicate that fats and some form of free phosphorus are the active agents. The luminous organs retain their power after death and even after desiccation and subsequent moistening; there seems to be no reason, therefore, to adopt the theory that we have to deal with any direct transformation of vital into radiant energy; the most probable explanation is that it is the result of slow combustion; but there still remains to be explained why this combustion produces extreme ultra-violet rays, while other forms of combustion do not.

Power.

SHOREDITCH DUST DESTRUCTOR. Baker. Lond. "Elec." and "Elec. Eng.," Oct. 21.—A communication making some deductions from the authorized and audited accounts of the vestry and claiming that the statements of the vestry clerk in his report are not borne out by the figures in the authorized accounts, and are consequently misleading. According to the clerk's report there is a net profit of over $6000 at the end of nine minths; the present writer finds instead a total loss of about $7000, the greater part of which is chargeable to the destructor system and represents the excess of the cost of the disposal of the refuse above the cost of the old system. He does not mean to infer from this that all destructors will be financial failures, as, on the contrary he thinks this plant shows glaringly the faults which may be remedied, and that 36 cents per ton for the disposal of the refuse without clinkers may be achieved, this figure having been recently reached in St. Pancras.

ELECTRIC PLOWING.—"Elek. Zeit.," Oct. 20.—An editorial in which, after briefly referring to the difficulties in making a proper comparison with steam plows, a brief description is given of the Dahlwitz plant at Hoppegarten. The central station has a capacity of 60 horse-power, an alternating current of 1000 volts being used for lighting and a continuous current of 500 volts for power purposes; this general application of electricity is one reason why the whole plant is commercially satisfactory. During the year 625 hectares are plowed at a cost of 12.5 marks (about $3.12) per hectare, which is considerably cheaper than with steam plows. The plow is worked by means of a cable, which passes across the field and back, the plow being attached to it; the cable is wound up on one drum and unwound from another. The depth of the furrows was from 20 to 25 cm (8 to 10 inches), and the width is 130 cm at a speed of 1 metre per second; the consumption of current at the central station was between 30 and 50 amperes at 500 volts.

KERKA WATER POWER PLANT. Giovaninelli. "L'Eclairage Elec.," Oct. 15.—The conclusion of the description of this proposed plant (see "Digest" last week). He discusses the economical features.

ELEVATOR EQUIPMENT FOR UNDERGROUND RAILWAY.—"Eng. News," Nov. 3.—A long article, accompanied by a double-page plate and various other illustrations, describing the electric elevator equipment for the Central London Underground Railway. This equipment is to be installed by an American company (the Sprague Electric Company), and is said to be much the largest elevator equipment ever contracted for; it is now being installed.

ELECTRIC POWER IN MINING. McGhie. "Cassiers' Mag.," Nov.—A short article calling attention to the very rapid progress made recently and to the advantages of using electrically driven machinery of various kinds. The article is accompanied by a large number of illustrations and brief descriptions.

TWO AND THREE PHASE SYSTEMS COMPARED. Stewart. "El'ty," Nov. 2; reprinted from Lond. "El'ty."—A short article discussing the question under what circumstances it is desirable to choose a two or three phase system for the transmission of power.

Traction.

USE OF HIGH VOLTAGES ON ELECTRIC RAILWAYS.—"L'Eclairage Elec.," Oct. 15.—The Swiss Government having raised an objection toward high voltages on electric railways, on the ground of danger, a Swiss manufacturing company obtained the views on this subject from three experts; these views are given in abstract in the present short article. The voltage which was to be used was 750. Kapp thought the Government was not justified in insisting on a limit of 500 volts, as that voltage was as dangerous as 750; from a practical standpoint 500 volts might be even more dangerous, as there is a false idea of security which does not exist; he recommends the use of circuit breakers or fuses to guard against connections with the earth. S. P. Thompson, like Kapp, thought that the dangerous voltage should not be limited to 500 and cites a fatal case in which the voltage was only 300; it is a mere matter of construction to protect a trolley line of 500 to 1500 volts. Weber gave the results of a set of experiments on the limit of security of the voltage of alternating currents; his results have already been published; his conclusions are that the use of high alternating-current voltages on railroads is very dangerous, but accidents have been rare; the dangers of high voltages are not great in comparison with the other dangers on railways, such as collisions, etc.; high voltages are necessary on economical grounds and a limitation of the voltage is therefore not justified.

THE DOOM OF THE TROLLEY.—Lond. "Elec. Rev.," Oct. 21.—An editorial calling attention to some recent statements by Dr. S. P. Thompson in a recently published article in some daily paper. He claims that if in Monaco electric cars can be run without either overhead wires or a slotted conduit, it is certain that they can be run in England also; he maintains that the slotted conduit is neither the alternative nor the best alternative for the trolley wire. His article is followed by a description of the surface contact system which he and Walker devised and which was described in THE ELECTRICAL WORLD, Oct. 22, p. 418.

GLASGOW ELECTRIC TRAMWAYS.—Lond. "Elec. Rev.," Oct. 21.—The beginning of an illustrated description of this new trolley line.

RAILWAY SHOP METHODS. Cravath. "Elec. Eng.," Oct. 27.—A short description of some of the methods used on a Chicago line. In order to keep the armatures dry through the winter months, when many of them are not in use, they are taken out of the cars and stored in a dry room. The method of checking out tools is described. Instead of the conventional form of hose for

car wiring, this road uses a specially made cable, containing the necessary number of conductors. The vestibule cars are being equipped with an illuminated route sign.

MOUNT LOWE RAILWAY. Ellison. "Sc. Am.," Oct. 29.—A short, popular description, accompanied by a number of picturesque illustrations, of the electric railway up this mountain in California.

Installations, Systems and Appliances.

SYSTEM OF CHARGING IN NEW YORK.—Lond. "Elec.," Oct. 21.—An editorial note commenting on a new system introduced by the Edison Company, in New York city. It is claimed that that company attempted to follow Wright's system, but did so only partially, so that the advantages of the system are lacking, leaving the new system little superior to the one used before. Instead of basing the differential rate on the maximum demand, it is based on the number of lamps installed; although this may encourage some extravagance by existing consumers, it will induce new consumers to put in as few lights as possible. It is thought that if the new system proves a success in New York, the Wright system would have given still better results.

BEST DIVISION OF UNITS IN A PLANT.—Lond. "Elec. Eng.," Oct. 21.—Answers to the question of what the most economical arrangement is in a direct-current three-wire system, the choice being between one steam dynamo of 200 kw and a balancing transformer, or two steam dynamos, each of 100 kw, or one steam engine and two dynamos coupled to it. Both writers give preference to the first system, although it is admitted that it is difficult to lay down any hard and fast rule owing to local conditions.

EVOLUTION IN CENTRAL STATION PRACTICE. Scott. "Eng. Mag.," Nov.—After a brief, general description of the alternate current systems and their characteristics, he points out the great flexibility of the polyphase system, citing the installations at Niagara Falls and Hartford as examples; he shows that the polyphase system affords a means for combining the whole service of a large station into a single unit, or for combining the power plants of many scattered stations into one single power plant. A table shows the principal items of cost, which are increased or decreased when a main power station and sub-stations replace several power stations. Some curves show the general relation between the first cost of different systems for conducting power; they show that the direct-current transmission is cheaper to install than a 2000-volt alternating with transformers if the distance is less than about a quarter of a mile, for 220 volts, or two-thirds of a mile for 500; the cost of copper for 2000 volts becomes excessive when the distance exceeds a few miles; the high first cost of rotary sub-stations can be justified only by economy in operation; the curves also show the advantages of the alternating current distribution over the direct through sub-stations. He believes that the electrical developments during the past ten years are due more to the engineer than to the inventor.

WASHINGTON.—"Elec. Rev.," Nov. 2.—A brief, illustrated description of the new station of the United States Electric Light Company, which has just been completed, and is said to be the most compact and complete station of its kind. There are connected with the station 73,000 incandescent lamps, 1500 arc lamps, besides 1700 horse-power for motors and power for a railway company having a 260-hp battery; both the direct and the alternating current are used, and almost all the power is distributed through underground wires, giving general satisfaction.

Wires, Wiring and Conduits.

CALCULATING WIRING.—Lond. "Elec. Eng.," Oct. 21.—Answers to a request to show how to calculate the size of mains for a given drop. One of the answers gives the following rule: Multiply the current by the length of wire in feet and divide the results by the loss of volts allowable; look up this result in a table, which he gives, and opposite to it will be found the proper size of wire.

RULES AND REGULATIONS.—"Elek. Zeit.," Oct. 20.—A German translation of some of the official rules in France concerning the construction of electric circuits.

Electro-Physics and Magnetism.

THEORY OF COHERERS. Van Gulik. "Wied. Ann.," 9, abstracted in the Lond. "Elec.," Oct. 21.—Two theories have been offered to explain the change of resistance in coherers due to electric waves; Branly thought that it was due to a modification of the dielectric separating the metallic particles; he supposes this dielectric to be endowed with conductivity. Lodge, on the other hand, assumed that a temporary metallic contact was established, the electric waves acting as a kind of flux. The present author described experiments to decide between the rival theories, and the results are entirely in favor of Lodge's view. The actual process of the establishing of contact may be imagined as follows: A minute spark perforates the dielectric, boring a sort of tube through it; very small particles are torn off the metallic surfaces and lodged in this tube, thereby forming a metallic conducting bridge, which is destroyed by the slightest shock.

CONSTRUCTION OF COHERERS. Dorn. "Wied. Ann.," 9, abstracted in the Lond. "Elec.," Oct. 21.—He examined the various metals with respect to their suitability for use in wireless telegraphy. The noble metals show practically no change of resistance; most specimens of nickel, which is the metal recommended by Marconi, were found to be useless; it was found necessary to take some metal which easily rusted, like iron. His results point to a considerable influence of the surface oxidation of the metal; the gas in the tube is also important. Neither exhaustion nor heating has any effect on a tube with aluminum filings. It is certain that the behavior of metallic filings is dependent upon many conditions, which it will be difficult to unravel completely.

NOMENCLATURE. Feldmann. "Elek. Zeit.," Oct. 20.—An article in which he suggests German names for the characteristic quantities in the designation of alternating currents. Besides suggesting the names, all of which are characteristically German, differing entirely from those used in most, if not all, the other languages, he describes what is meant by each of the expressions and how the numerical values of the quantities and their relations are calculated. Among the quantities considered are reactance, impedance, admittance, their relations, etc.

DIFFUSION OF ROENTGEN RAYS. Malagoli and Bonacini. "R. Acad. Lincei," 7, p. 96; noticed briefly in "Science Abstracts," Aug.—They describe experiments tending to show that the influence of the intervening air as a diffuse reflector is extremely small, and that the apparent bending of the Röntgen rays is due mainly to the action of surrounding bodies.

OBSCURE CATHODE REGION. Wehnelt. "Wied. Ann.," June; abstracted at considerable length, with numerous illustrations, in "L'Eclairage Elec.," Oct. 15.—Descriptions of the apparatus, experiments and results.

MAGNETIZATION AND CONDUCTIVITY. Milani. "Nuovo Cimento," 6, p. 191; noticed briefly in "Science Abstracts," Aug.—He showed by a series of carefully made experiments with strong fields that the alleged influence of magnetization on the electric conductivity of a solution of ferric chloride parallel to the lines of force does not exist, or is too slight for detection.

MAGNETIC DEFORMATION OF NICKEL. Jones. "Roy. Soc. Proc.," 63, p. 44; abstracted briefly in "Science Abstracts," Aug.—He measured the magnetic contraction of nickel wire and compared the results with the values deduced from Kirchhoff's theory; the observed contraction was much greater than the calculated.

SUN SPOTS AND VARIATION OF MAGNETIC ELEMENTS. Ellis. "Roy. Soc. Proc.," 63, p. 64; noticed briefly in "Science Abstracts," Aug.—The data given cover the period 1841-'96; the three curves representing the number of spots, the diurnal ranges of declination and of horizontal force, are of the same general form, the maxima and minima occurring at the same time for all. He concludes that these three phenomena must therefore be due to some common cause.

NICKEL-STEEL. Guillaume. "Sc. Am. Sup.," Oct. 29; translated from "La Nature."—A short, illustrated article on the magnetic and other properties; it contains some data.

PHOSPHORESCENCE. Jackson. "Sc. Am. Sup.," Oct. 29.—A reprint of his Brit. Assn. paper.

Electro-Chemistry and Batteries.

ELECTRO-DEPOSITION OF CADMIUM AND ITS ALLOYS. Cowper-Coles. Lond. "Elec. Rev.," Oct. 21.—A short article enumerating the properties of cadmium and describing briefly the ways in which it may be deposited; cadmium can now be bought of a good quality at a low rate; it is suitable for coating the terminals of primary and secondary batteries and for preventing the corrosion of steel. Lately cadmium had been extensively deposited as an alloy with silver; with a small percentage of silver it has been used during the last three years for coating bright steel parts of machines, such as bicycles, and an alloy containing 75 per cent. of cadmium has been extensively used for plating domestic articles; this alloy withstands the tarnishing effect of the atmosphere much better than fine, pure silver. A silver cadmium alloy is electropositive to nickel, therefore when it is used for coating steel the corroding action of the air and water is much more violent in the presence of nickel than of the alloy, owing to the more intense electrical action with the former (unfortunately he does not state whether it is also electropositive to iron, like zinc, the electrochemical action of which with respect to iron is the reverse of that between nickel and iron); samples of nickel-plated iron and iron coated with this alloy were subjected to different corroding influences and showed that while the former rusted badly in a short time those coated with the alloy were but little corroded; the coating of the alloy is less porous than the nickel. The process of depositing the alloy from the cyanide of the two metals is described, but the determinations of the best conditions require careful experiment and much time and trouble; some remarks roughly indicating the laws governing the deposit are given.

ELECTRO-DEPOSITION OF COPPER.—Lond. "Engineering," Oct. 21.—A short article calling attention to the electrolytic refining of copper and referring briefly to the improved Elmore and the Dumoulin processes of making tubes and sheets of copper. There are about thirty-one electrolytic copper refineries at work in Europe and America. Over one-third of the total output of the world is now electrolytically refined. The method, which is practically the same in all, is described briefly; the value of the so-called impurities, which contain gold and silver, amounted in one year to over three and a half million dollars in the plant of the Anaconda Company; the value in all the refineries in Europe and America is estimated to be about $8,300,000 per year; the gold and silver obtained are more than sufficient to cover the cost of the operation of the refining. In connection with a description of the Elmore process, the defects of which are now said to have been overcome, it is stated that a satisfactory tube free from all the objections ob-

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served in the older process is now obtained. In connection with the Dumoulin process, a description of which was noticed in the "Digest" last week, it is stated that the smooth deposits are obtained by the application of an insulating coating to the inequalities which form on the surface; the impregnators, which move over the surface of the metal, coat all projecting parts with a thin film of animal matter, which hinders further deposition until the surrounding depressions have been raised to the common level (this was not clearly stated in the previously cited description). It is claimed that there is now no doubt that these two processes can turn out satisfactory products.

COMMERCIAL ELECTROLYSIS OF WATER. Garutti. "Elettricita," 17, p. 152; abstracted in "Science Abstracts," Aug.—The chief difficulty in the electrolytic preparation of hydrogen and oxygen lies in the complete separation of the gases. In his process he uses a metallic diaphragm inserted in the cell, but not reaching the bottom, so as to allow sufficient space for the passage of the liquor from one electrode to the other. A plant of thirty-two cells, yielding daily 30 cu. m. of oxygen and 60 of hydrogen, has been working for six months, and the gases are sufficiently pure for commercial purposes, the oxygen containing about 1.5 per cent. of hydrogen and the hydrogen only a trace of oxygen.

The "Sc. Am. Sup.," Oct. 29, translates a short, illustrated article from "La Vie Scientifique," describing this process briefly; it is operating very satisfactorily and economically in Italy, Switzerland and Belgium, yielding very pure oxygen at a cost of less than half a cent per cubic foot, leaving a large margin of profit. The electrolyzer consists of steel-plate cells, the bottoms of the diaphragms being provided with small apertures, allowing the electrolyte to pass through, but not the gas bubbles, thus preventing the gases from mixing.

PRODUCTION OF ALUMINUM AT FOYERS.—"Soc. Chem. Ind. Jour.," 17, p. 308; abstracted in "Science Abstracts," Aug.—A description of this water-power plant. The practical yield of the metal is 1 pound per 12 electrical hp hours.

TREATMENT OF SULPHIDE ORES. Steinhart. "Industries and Iron," 24, p. 262; noticed in "Science Abstracts," Aug.—He discusses the treatment of ores containing lead, zinc and silver, by quite a number of different processes.

ELECTROLYTIC HYPOCHLORITE. Volta. "Elettricita," 17, p. 312; noticed briefly in "Science Abstracts," Aug.—A description of the Tailfer process. The chlorine and soda produced by the electrolysis of the salt are conducted to a special absorbing vessel, where the hypochlorite is formed by their mixture, which thus takes place outside of the cell; this is the special feature of the process. The product thus obtained contains 20 to 30 times its volume of available chlorine; the electrolyte contains 250 grams of sodium carbonate per liter; 400 kg of hydrochlorite are produced with 100 amperes at 100 volts in twenty hours; the cost of production is one-third of the present market price of the hypochlorite.

CHEMICAL EQUILIBRIUM AND E. M. F. Knuepffer. "Zeit. Phys. Chem.," 26, p. 254; abstracted in the "Zeit. f. Elektrochemie," Oct. 20.—He used a certain reaction to study the relation between these two quantities and the conversion of chemical into electrical energy. The reaction which he uses represents a cell which, according to the temperature and concentration relations, acts sometimes with the evolution of heat and sometimes with the absorption of it.

INTERNAL FRICTION OF SALT SOLUTIONS. Euler. "Zeit. Phys. Chem.," 35, p. 536; abstracted briefly from the "Zeit. f. Elektrochemie," Oct. 13.—The object of the researches described was to determine the law connecting the friction of salt solutions with the friction of the ions, to determine the friction coefficient of different solutions and to compare them with the migration velocity.

OSMOTIC PRESSURE. Larmor. "Cambridge Phil. Soc. Proc.," 9, p. 240; abstracted briefly in "Science Abstracts," Aug.—He considers that the thermo-dynamic basis of the law of osmotic pressure is valid, while the hypothesis of ionic dissociation must be judged separately by its agreement with facts.

ELECTROLYTIC STAND.—Lond. "Elec. Rev.," Oct. 21.—A brief, illustrated description of an improved stand devised by Marshall for electrolytic research. The upright post consists of a concentric tube and rod, insulated from each other and connected at the base with the wires, thus doing away with all wires around the apparatus itself.

COMPARISON OF ACCUMULATORS. Shoop and Benndorf. "Elektrochem. Zeit.," Oct. 21.—The first part of a very long article in which they describe and give the results of experiments undertaken to compare accumulators of different systems with each other, so that the best system could be selected for any given purpose; they compared three quite different systems of accumulators. The first portion is a long dissertation describing the meanings of the terms and the characteristic properties of accumulators; this appears to be a good summary, but does not seem to contain anything new. The question often asked, Which accumulator is the best? cannot be answered in a general way; in each particular case certain conditions will determine the choice; the only question which can arise is which system is the best for any particular case, the answer to which is, that which at the desired output and satisfactory efficiency is the most reliable and involves the least cost of maintenance, in which is included the interest on the original cost. They lay particular stress on tests made with an auxiliary electrode of cadmium; this consisted of a rod of cadmium, like a pencil, immersed so as to offer a surface of about 10 cm; the voltage between this electrode and each of the others, both while the current is flowing and after it has been stopped, were measured and all these figures are given in the voluminous tables; the sum of the voltages measured between this electrode and the two plates should be, and was found to be, equal to that between two plates; such a test shows the condition of each of the plates separately. According to Exner, the difference of potential between cadmium and sulphuric acid of 1.15 sp. gr. is about + 1 volt, and if, therefore, 1 volt is deducted from the reading between the cadmium and the positive plate, the remainder will give the e. m. f. of that plate; subtracting that between the cadmium and the negative plate from + 1 volt will give the e. m. f. of the spongy lead plate. The three cells had almost equal capacities and were always connected in series. They were discharged at various rates and charged at 7 amperes until gas was evolved at both electrodes; moreover, they were always charged with one-fifth more than the previous discharge. The accumulators tested were the Baumgarten, the Guelcher and the Oblasser; the results of the first two are given in voluminous tables in the present installment; these tables give the time, the current (which was kept constant in each discharge) and the various voltages with the auxiliary electrode described above, besides the differences between the calculated and the observed results, both on open and closed circuits. A brief description of each of the systems is given, together with the various weights of the different parts.

RESTORING SULPHATED ACCUMULATOR PLATES.—"Elektrochem. Zeit.," Oct. 1.—A short article describing a method (which is not new) of restoring badly sulphated plates so as to make them useful again. It consists in connecting such a plate to one of zinc, in sulphuric acid; the action of the zinc will reduce the sulphate to spongy lead. (When this is applied to the positive plates it should be understood, although not so stated, that it will reduce not only the sulphate, but also the remaining peroxide, to spongy lead, and the plate will then have to be formed over again to convert it into a peroxide plate).

THEORY OF THE LEAD ACCUMULATOR. Dolezalek. "Wied. Ann.," 65, p. 894; noticed in the "Zeit. f. Elektrochemie," Oct. 20.—A complete publication of his article, of which a condensed form was noticed in the "Digest" Mar. 12. Incidentally it may be mentioned that in order to show that the low capacity of accumulators is due to the lack of acid he describes experiments in which an accumulator plate is so mounted that during the discharge sulphuric acid is forced through it, when the capacity will be almost three times as great as under ordinary conditions.

JACQUES CARBON CONSUMING CELL. Skinner. Lond. "Engineering," Oct. 21.—A brief notice of his Brit. Assn. paper. He found that the air, which is blown into the fused soda, acts by keeping the iron surface clean; hydrogen peroxide added to the soda has the same effect. He hopes to determine the electrochemical equivalent of carbon from the current of the cell and the loss in wight of the carbon electrode.

THEORY AND CONSTRUCTION OF GALVANIC CELLS. Platner. "Elektrochem. Zeit.," Oct. 1.—A short article on the chemical process in the zinc cell and on the depolarization by chlorate; no general conclusions seem to be drawn.

Units, Measurements and Instruments.

INSULATION INDICATOR FOR DISTRIBUTION WIRES. Kallmann. "Elek. Zeit.," Oct. 1.—The conclusion of his long paper (see "Digest" last week). He shows how his indicator may be applied to a two-wire system; this can readily be inferred from the description previously given. He mentions briefly that there would be no deflection of the instrument for the case in which the leakage current from the two wires is equal; he claims that this "apparent" lack of deflection would very rarely occur, but when it does an additional test is easily made, and this consists in connecting momentarily a relatively small resistance, say of a few hundred ohms, between either pole and the earth; the highest deflection is then to be taken as the proper indication. (He does not appear to point out that, in general, his indicator always shows merely the difference between the two leakage currents and that only in the exceptional case in which one of the lines is perfectly insulated will his indicator give the correct leakage current; the absolute equality of the two leakage currents may be exceptional, but some leakage from both is certainly the rule; this intrinsic fault of the instrument does not seem to be brought out clearly.) He then shows how it is applied to a three-wire system, but neither the diagram nor the explanation is quite clear; it seems as though he applied the galvanometer to each of the two-wire halves successively, as he states that only one instrument is necessary; in this application he states that the instrument shows the difference between two differences of currents. He then shows the application to two-wire systems in series—that is, to the beginning and end of a long-distance transmission, for instance, or to the distribution branches at the ends (this, of course, involves the use of two or more testing wires from the distant end back to the near end, an important element in his system which is not emphasized); one is therefore enabled to measure the leakage current of distant distribution wires from one point. In conclusion he gives an illustrated description of the model which he used in his experiments (as he does not state that the instrument is in practical application, it is to be presumed that it has not yet been so used). He emphasizes the fact that this instrument shows the condition of insulation, not by means of the resistance to earth, but by the leakage current, and

claims this to be the preferable method; rules and regulations should allow for a definite proportion of leakage current instead of requiring a certain insulation resistance.

INDICATORS.—"L'Eclairage Elec.," Oct. 15.—Brief descriptions, illustrated with diagrams, of several Siemens & Halske indicators. One of these is to give a signal when the voltage varies more than a certain amount; it consists simply of an electromagnet which operates one of two relay circuits when the voltage is too high or too low. The others are a ground indicator, a current indicator and one showing the direction of the current; they do not seem to be of especial interest.

PLATINUM VOLTMETER Callendar and Griffiths. Lond. "Engineering," Oct. 21.—A brief abstract of their Brit. Assn. paper. The current strength and voltage of continuous or alternating currents were determined from the rise of temperature of a platinum wire, which is not subjected to any strain and can therefore be much finer than any voltmeters of the Cardew type; the instruments have no magnifying gear, are very sensitive, absorbing little current and having very wide ranges; they are especially adapted for determining fluctuations in the neighborhood of 110 volts. In the recording device a pen is attached to the sliding contact of the galvanometer in a straight bridge wire, and is kept automatically at the balance point by means of a delicate relay controlling a pair of collector motors. No further description is given in the abstract.

HOUR METER.—"L'Elec.," Oct. 22.—An illustrated description of the Richard hour meter, consisting essentially of a pendulum which is started when the current is started and stops when the circuit is open, indicating the total time of the flow of the current in hours; it rewinds itself automatically every twenty seconds.

ELASTIC MOMENT OF SPIRALS. Guillaume. "L'Ind. Elec.," Oct. 10.—A short discussion on the proper way of stating and measuring the elastic moment of spirals. The logical unit is the unit couple divided by the unit angle. In practice the measurement of the couple can be replaced by the measurement of the oscillation of a known moment of inertia.

NATIONAL PHYSICAL LABORATORY.—Lond. "Elec. Rev.," Oct. 14.—An editorial on the report noticed in the "Digest" Oct. 29. It is claimed that the proposed arrangement probably satisfies the wishes of no one concerned, but it has the merit that the Government may accept it.

The Lond. "Elec.," Oct. 21, contains a communication by C. E. He claims that the conclusions of the committee are vague and indefinite on the most important points—namely, the scope and purpose of the proposed laboratory.

Telegraphy, Telephony and Signals.

INDUCTIVE DISTURBANCES IN TELEPHONES. Laarmann. "Elek. Rundschau," 15, p. 132; noticed briefly in "Science Abstracts," Aug.—The disturbances due to the neighboring currents may to some extent be compensated by the Brockelt method. The primary of a coil is placed in series with the telephone line circuit and the secondary is connected as a shunt between the two points of that circuit; so that the secondary currents oppose and neutralize the primary. The telephones are connected in the shunted portions of the line; or another induction coil may be inserted in the shunt portion, the primary being to line and the secondary to receivers. The telephone current is only slightly weakened; it is claimed to be very effective.

MODERN TELEPHONY. Wehrenalp. "Zeit. fuer Elek.," Oct. 16.—The continuation of his long serial (see "Digest" July 9). In the present portion he discusses telephone central stations and their construction and arrangement.

NEW SYSTEMS OF TELEGRAPHY.—"El'ty," Nov. 2.—Brief descriptions of two new systems. One is that of Professor Rowland, which is shortly to be tried between New York and Philadelphia; it will transmit four messages in each direction at the same time; it is a printing telegraph, the keyboard being like that of a typewriter and the message being received in type either on a sheet or a tape. The advantages are that no skilled operator is required at either end, and that a large amount of time is saved; an ordinary typewriter operator could send messages at the rate of forty words per minute, making the capacity of the wire eight times this. This is practically all that is said about it. The other system is the duodecaplex system of Mercadier, which is now being experimented with on an extensive scale over the line connecting Paris and Bordeaux. Twelve messages can be sent simultaneously over the same wire with ordinary Morse transmitters; the principle appears to be that of the well-known harmonic system; uninterrupted currents and tuning forks are used, each transmitter and its receiver being tuned to the same frequency; the signals are heard by ear through a telephone.

LIMITING DISTANCE OF TELEPHONE SPEECH. Dobbs. "Elec. Eng.," Oct. 27.—After stating that the limiting distance has not yet been found, he discusses the K R law, the correctness of which is claimed by some English writers, and which says that the limit of speech is reached when the capacity in microfarads multiplied by the resistance equals 50,000. He calculates the capacity of a number of different wires and the limiting distances according to this law; in a line from Boston to Omaha this product would be over 400,000. He discusses the American practice of clearing the line of static charge by increasing the self-inductance and leakage, and of balancing the static capacity with a mutual self-inductance. A form of telephone lightning arrester is illustrated.

TELEGRAPHY WITHOUT WIRES.—"Sc. Am. Sup.," Nov. 5.—A brief, illustrated description from "La Nature" of the Dosne apparatus for performing experiments in wireless telegraphy.

Miscellaneous.

INFLUENCE OF ELECTRICITY ON PLANTS. Lemstroem. Lond. "Engineering," Oct. 21.—A brief abstract of his Brit. Assn. paper. He gives a summary of his researches since 1885 concerning the relations between atmospheric electricity, the aurora, sun spots and plant growth. An increase in plant growth amounting to 40 and even 75 per cent., but varying with the different plants, was observed; it was found, however, that when water is wanting electricity, which gives rise to an energetic absorption of moisture, may prove injurious; tobacco prospered remarkably when kept well watered at the same time; he stretched wires connected with a static machine and provided with points across the fields; he ascribes the beneficial effects either to the formation of ozone and nitric acid, or more probably to the electro-capillary phenomenon of Gernez—that is, that water rises in a capillary tube higher than it does normally when a point electrode, positive or negative, is inserted in the tube at the top.

BRITISH ASSOCIATION.—Lond. "Engineering," Oct. 21.—The continuation of the brief abstracts and notices of a large number of the papers, some of which have been noticed under their respective headings in the "Digest." The report of the committee on electric standards describes the progress made in the determination of the ampere. Solomon described the determination of the temperature coefficients of the two 10-ohm standard coils used by Ayrton and Jones in their determination of the ohm. Ayrton and Jones described their ampere balance in detail. Fawcett described a standard high resistance prepared by depositing upon glass in vacua, cathode films of alloys, and heating them afterward in a partial vacuum. A platinum gold alloy of a temperature coefficient of 0.01 per degree C. seems the more suitable, but this coefficient varies with the thickness of the film; the resistances of one megohm and upwards have not changed by more than 0.001 per cent. during a period of four months. Barrett, Brown and Hadfield presented a report on the electric conductivity and magnetic permeability of new alloys of iron, principally nickel steels; the paper is said to be of considerable practical importance, but is not abstracted. Rosa and Smith measured the heating effect of an alternating voltage on the dielectric of a condenser; they found that paraffin paper wastes very little energy, while with beeswax and resin the loss was much greater. Lodge described an attempt to construct a magnifying or bellowing telephone, but succeeded only with the former; the opinions were fairly unanimous that an attempt to increase the human voice to a bellow must fail because it is mechanically impossible to set a sufficient quantity of air in motion; he succeeded in magnifying the sound to the intensity of the human voice, but no more. Chattock measured the velocity of electricity in electric wind and concludes that the electricity in wind travels faster than the gaseous particles themselves; also that negative electricity travels quicker than positive; (the question arises, What is it that travels?) Cook, in a paper on the brush discharge, described a number of experiments, illustrated with many photographs. There were two papers on the Zeeman effect, one by Preston and one by S. P. Thompson. There were three papers by Lord Kelvin, the first on the dynamical theory of refraction and anomalous dispersion; another on the continuity of the undulating theory of sounds, elastic solid light and electric waves, in which he comes to the conclusion that no continuity could be shown; the third was on the graphic representations of the two simplest cases of a single wave. A paper by Callendar and Griffith on the measurements of small differences of resistance is noticed; the apparatus was described some years ago, but has been perfected and now measures the resistance to within one part in three million. The report on electrolysis, which is said to be an important one, is briefly abstracted. It includes a paper by Griffith on dilute solutions and one by Whetham on conductivity of dilute solutions.

ELECTRIC CURRENT AND THE LAW. Meili. "L'Eclairage Elec.," Oct. 15.—A translation in abstract of his article noticed in the "Digest" June 25 and April 30.

LIGHTNING ON KITE WIRES.—"Sc. Am. Sup.," Nov. 5; reprinted from the "Monthly Weather Review."—An article describing some of the recent experiences of the observers of the Weather Bureau in connection with kites in which the kite wires were destroyed by heavy electric discharges. In one case the wire was completely destroyed, the amount being 12,500 feet; particles of melted wire adhered to the reel; the kite at the time was in a comparatively clear sky. In another case there appeared to be a rope of smoke along the wire, which latter was quickly consumed by a powerful bolt of lightning; fire seemed to rise to the kite, and the wire seemed to be on fire along the whole length; in one case the concussion of the bolt was very great. Four cases are described. The whole subject is briefly discussed; according to Elster and Geitel, the whole earth can be considered either as a sphere with a negative charge acting on the regions above it by induction, or the atmosphere can be considered as the dielectric of a condenser of which the earth is the negative side and the upper layers of the

atmosphere the positive. There appear to be at least three different conditions leading to the electrification of the kite line; in some cases the discharges are strictly momentary; Professor Marvin says that in such cases the wire is the receiving instrument in an immense wireless telegraphy system, the signals over the wire being indications that lightning is passing at some far distant point; the currents may be called inductive discharges and may in some cases be strong enough to fuse the wire; in other cases it may be actually struck by lightning. The kite wire used by the Weather Bureau is 0.028 inch in diameter, having a tensile strength of 210 pounds; a current of 15 amperes is required to heat and maintain the wire at a red heat when its resistance is about 0.7 ohm per foot, or about five times that when cold; from this it is calculated that the discharge which fused 12,000 feet of wire in one case was at least 130,000 volts.

An Improved Telephone Switchboard.

The illustration at the bottom of this page gives a view of a new switchboard equipment recently installed in the exchange of the Home Telephone Company at Trenton, N. J. This board was manufactured by the American Electric Telephone Company, of Chicago, and, it is claimed, represents a distinct advance in the art of switchboard construction. It embodies all of the latest improvements, and is fitted with 1200 drops, with a capacity in its transfer system for 2000 drops. It is built for full metallic circuits, and is provided with the company's self-restoring express drops. The transfer system is fitted with the latest improvements, using incandescent electric lamps for signaling.

It will be interesting to independent telephone managers to know that this company is able to successfully carry through in an up-to-date manner any telephone construction work, however extensive or expensive it may be.

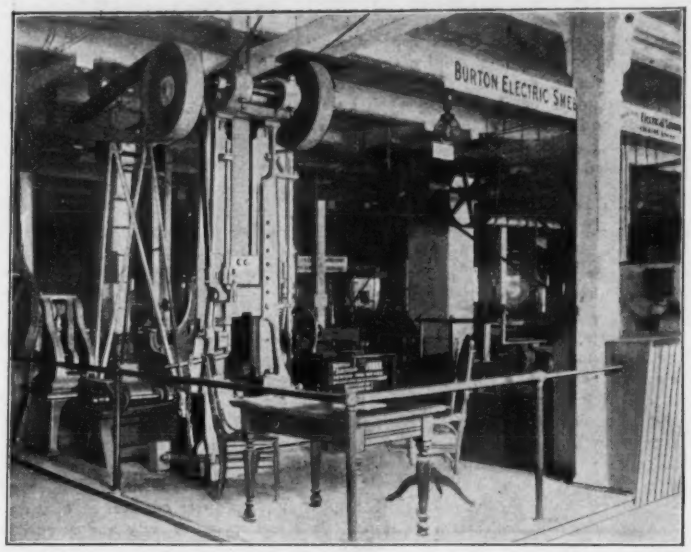


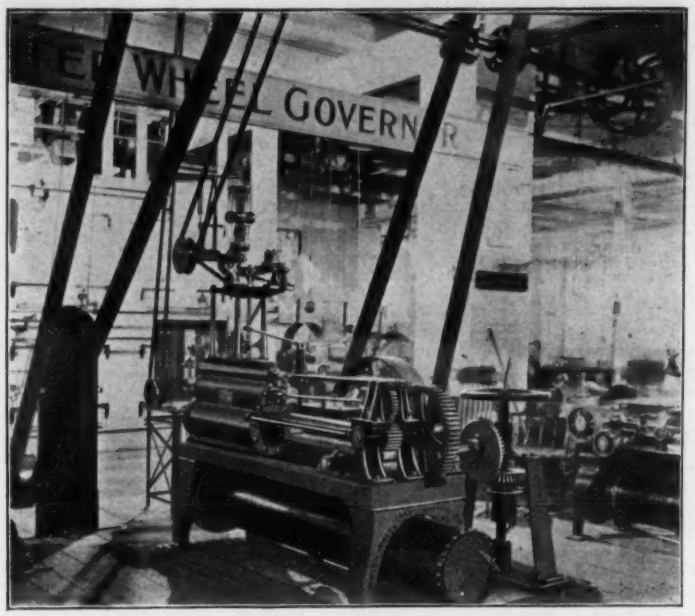
EXHIBIT OF THE BURTON ELECTRIC SMELTING COMPANY.

Some of the Exhibits at the Mechanic's Fair, Boston.

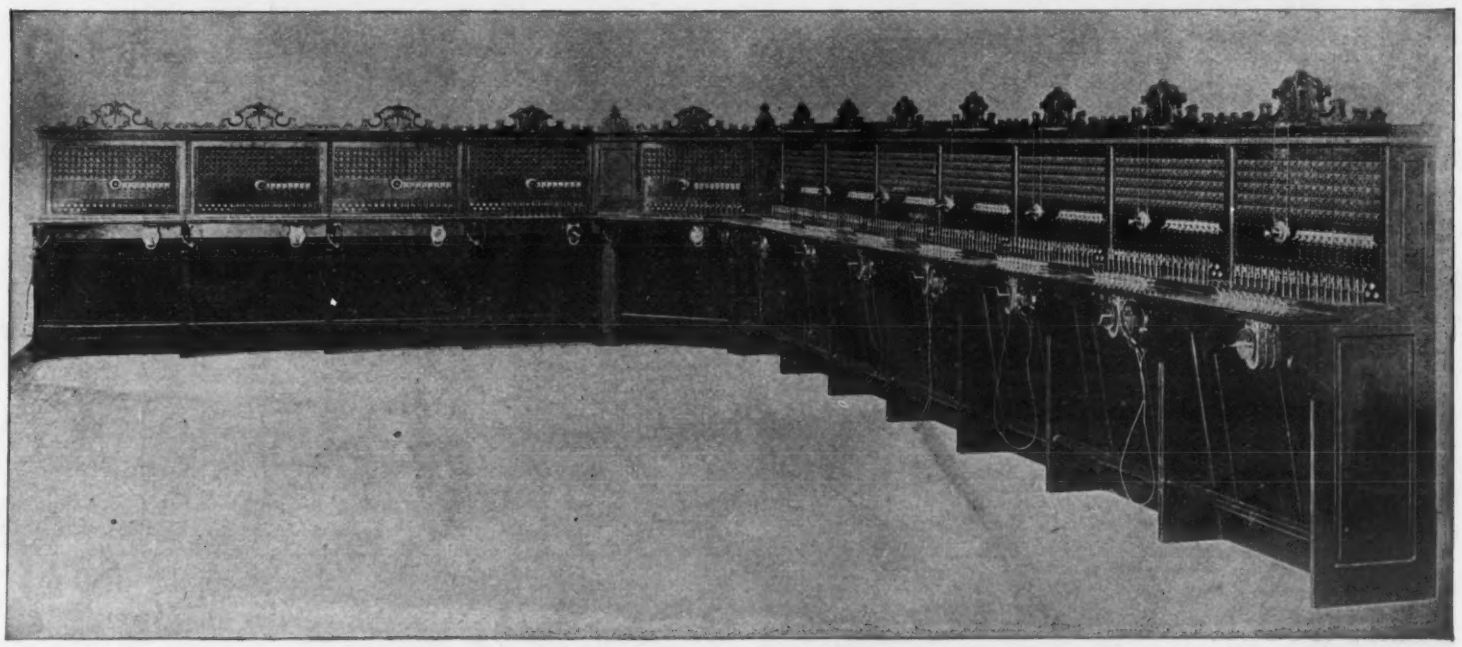
THE BURTON ELECTRIC SMELTING COMPANY, of Boston, makes an elaborate exhibit of its smelting apparatus and some of the other electrical inventions of Mr. George D. Burton. Several liquid forges are in service besides the one in the Edison exhibit, and attract a great deal of attention from the uninitiated, who are astounded to see metal melted and cooled in the same water. A power-driven punching machine is also in the exhibit, driven by a Belknap motor to show the practical use of the forges. Electric current for welding and forging by dry processes is generated by an Eddy 15-volt, 1200-ampere machine, belted to a 20-hp motor and connected to an anvil by 2-inch solid copper rods. Souvenirs are distributed made by electric forging processes.

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, Boston, Mass., exhibits one of its type "B" governors set up and in operation as it would appear in connection with a water wheel. This Type "B" is the form of Lombard governor which is most often used in electrical plants. Of the 80,000 horse-power of water wheels which is now being governed by Lombard governors about 40,000 horse-power is being regulated by the type of governor shown in the exhibit. Types "A" and "F" are also shown, the former being for small turbine plants and the latter for Pelton and other impulse wheels.

THE STANDARD THERMOMETER & ELECTRIC COMPANY, Peabody, Mass., shows a full line of samples of eighteen different styles of enclosed arc lamps, giving several varieties of cases and many combinations of different types of inner and outer globes and reflectors. One 220-volt lamp takes from two to three amperes maintaining, it is claimed, from 140 to 150 volts across the arc. Multiple-series lamps for 220-volt circuits and taking from four to six amperes are also shown, as well as a straight series lamp, the latter being fitted with a short-circuiting cut-out mounted immediately over the lamp in an inverted cup-shaped shield, taking the place of the ordinary hanger-board



THE LOMBARD WATER WHEEL GOVERNOR COMPANY'S EXHIBIT.



SWITCHBOARD IN THE EXCHANGE OF THE HOME TELEPHONE COMPANY, TRENTON, N. J.

cut-out. The company's alternating-current enclosed arc is of interest in that the same lamp is made for any commercial frequency and without change of adjustment will burn on circuits with a pressure anywhere from 100 to 120 volts. The lamp maintains a potential of eighty volts across the arc, there being no resistance in the controlling circuit but that of the series solenoid. The lamp

Exhibit of the Standard Thermometer and Electric Co.

is also remarkably noiseless, due to the use of felt between the gear and the case, removing the resonant effect of the latter. The alternating-current lamp is trimmed with a five-eighth-inch cored lower and one-half-inch solid upper carbon, the increased size of the lower carbon giving a life of from 120 to 135 hours. Mr. Roger Upton is the designer of this line of lamps.

The Cahill & Hall Direct Electric Elevator.

Several radical departures in elevator construction have been developed by the Cahill & Hall Elevator Company, San Francisco, and embodied in an electric elevator, the correct scientific principles and ship-shape design of which are most pleasing to those versed in this line of work. The greatest novelty in this machine is the system of roping, which is outlined in the accompanying drawing. The two hoisting ropes are virtually endless and are not fastened into any hoisting drum or multiplying sheaves. They are driven, as are the cables of cable railways, or the winding ropes of balanced mine hoists, solely by their friction upon the two driving sheaves of the winding engine indicated in the lower part of the figure. This construction allows of these winding ropes to slip in case there is any slack in the outgoing end, a principle which is ingeniously turned to account, as described below. The two winding ropes are not fastened to the cage, but run from the upper end of the counterweight over a sheave down to and around the double driving sheaves of the winding machine; from them under an idler sheave mounted at the back end of the machine, as shown in the photographic illustration, and up again to the under side of the counterweight. The machine itself is hinged near its forward end, and the greater part of its weight is supported in the bight of the winding ropes passing under the above-mentioned idler, this weight always giving a certain predetermined tension to these winding ropes. The car of cage is simply supported by ropes direct from the top of the counterweight. The combination may, of course, be over-counterweighted to balance the average load of passengers and thus to give the greatest economy of power. In winding it is obvious that should either the car or the counterweight strike an obstruction, such as the bumpers, or become bound by the setting of the safety stop or for any other reason, the increased upward pull of the winding ropes—no matter which way the machine were running—would tend, as soon as it more than overcame the weight on the idler sheave, to make that end of the machine climb up the ropes. This would remove all tension from the outgoing end, which would immediately allow the cables to slip on the winding sheaves. This is a feature which exists in no other electric-elevator equipment, and is undoubtedly of great value, owing to the fact that with rigid connection between the rope and the winding machine, in case of any obstruction, the enormous strains attainable before the fuse blows, especially with worm gears or screws, aided by the momentum of the motor, strain all parts of the equipment and tend to break the ropes, sheaves or fastenings and allow the cage to drop.

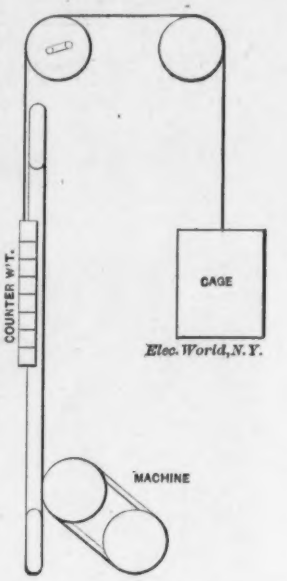


Fig. 1

The motor is of rectangular yoke, double-pole iron-clad design without magnetic joints in the field frame, cumulatively compound wound, and is rated at 15 horse-power at its normal speed of 800 r. p. m. Its weight is 2400 pounds. Tests made by Mr. E. S. Cobb showed a starting torque of 2448 pounds at the surface of the 10-inch armature, with all the controlled resistance thrown in and with no material heating in either rheostat or motor.

The armature shaft is connected through insulating couplings to a shaft carrying right and left hand worms, which respectively mesh with gears coupled to the two driving sheaves. This arrangement balances the end thrust on the worm shaft, and that without the fine adjustment necessary with the ordinary right and left hand worms driving one drum, since with the arrangement here shown the load is automatically equalized between the two driving sheaves at all times. Two independent magnetically operated brakes operate pulleys on the worm and armature shaft. Both are set by gravity and released by solenoids, one being that used in the regular operation and controlled within the cage, the other being connected up with contact strips on the car which open its circuit at the terminals of the car travel, its operation also opening a switch carrying the current to the armature circuit of the motor and to the other brake. Thus the terminal stops cut off the operating current and set both brakes.

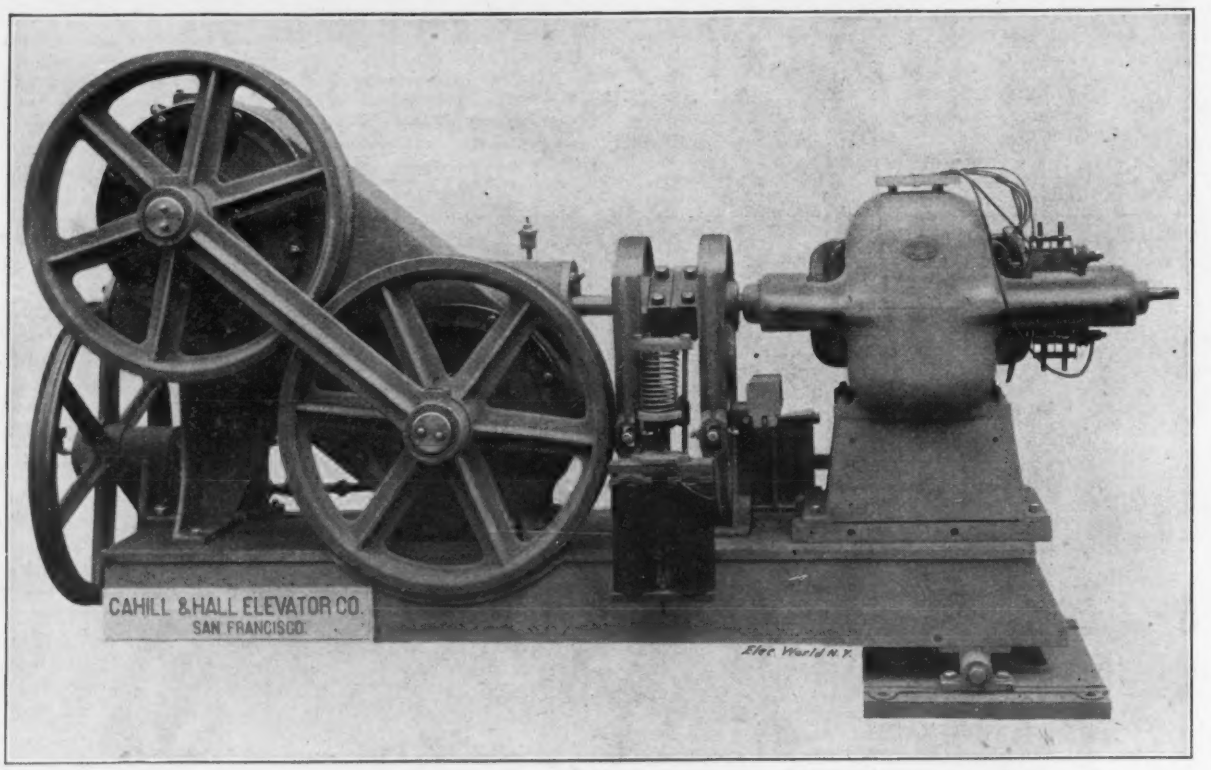


Fig. 2.—Mechanism of the Direct Electric Elevator.

NEWS OF THE WEEK

Financial Intelligence.

DIVIDEND.—The directors of the Erie Telephone & Telegraph Company have declared the regular quarterly dividend of 1 per cent. payable on November 21.

THE NEW YORK & NEW JERSEY TELEPHONE COMPANY has filed a certificate at Albany, N. Y., of an increase in capital from $5,000,000 to $8,000,000.

THE BROOKLYN RAPID TRANSIT COMPANY in its October statement reports gross earnings of $525,135, which is an increase of $65,613, as compared with the gross earnings for the same month last year.

Special Correspondence.

NEW YORK NOTES.

MR. HENRY FLOY, who last August resigned his position as manager of the Minneapolis office of the Westinghouse Electric & Manufacturing Company, has, with Prof. R. C. Carpenter, of Cornell University, opened a consulting engineer's office in the St. Paul Building, 220 Broadway, New York. The firm, under the name of Floy & Carpenter, is securing its share of consulting business, and is at present doing work for the Utica Belt Line Railway, Ithaca Street Railway, the Standard Oil Company, the Youngstown Gas Company and other concerns.

ATMOSPHERIC POTENTIAL.—Mr. William A. Eddy, the kite expert, has recently made some rough experimental determinations of the difference of potential between the atmosphere and the earth in the neighborhood of the Statue of Liberty on Bedloe's Island, in New York harbor. It was the prevalent idea that this large mass of metal would to a certain extent equalize the potential between the ground and the atmosphere in the neighborhood, but metallic kites sent up to a height of about 350 feet gave greater sparks to ground when within 30 feet of the head of the statue than when 500 feet away, apparently showing that the statue tends, if anything, to increase the potential in the neighboring strata rather than the reverse.

DARKNESS ON A LIGHT SUBJECT.—Mystery still surrounds the New York Gas & Electric Light, Heat & Power Company as to its real identity and purposes. Much speculation has been indulged in over the plans of this company, and many opinions have been expressed on the subject, but as yet the officers have kept their own counsel and not admitted the interested public to their confidence. During the past week another theory has been evolved, which may or may not have some elements of truth in it. It hails from Philadelphia, the home of gas and electric combinations, and it is to the effect that Messrs. Widener, Elkins and Dolan, of that city, are interested in the New York enterprise, and propose to bring about the consolidation of all the electric light interests in Greater New York. Another and later rumor is to the effect that the company has purchased the Consolidated Telegraph & Electrical Subway Company, of this city, paying therefor $6,000,000. This step is, according to the story, necessary in order to carry out the alleged purpose of consolidating the electric light business in Greater New York, and using the surplus power of the street railroads in the general scheme for furnishing light and power.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of Brooklyn, recently executed a mortgage for $10,000,000 to secure a like amount of bonds, $2,000,000 of which were to be issued immediately. The question arose as to the amount of internal revenue tax to be paid on the document, and the company referred to the Internal Revenue Collector of Brooklyn for an opinion. That official submitted the matter to the Commissioner of Internal Revenue at Washington, who, in rendering an opinion, states that the company is mistaken in believing that it will only have to pay tax on the $2,000,000 worth of bonds now issued. He states that the instrument is a fully executed and completed contract, which provides for a specific and liquidated amount of money, upon which this company lodges its credit. There will be required no other instrument when each issue of bonds is made, although these issues are in future. The commissioner's office considers the instrument to be unquestionably a mortgage for $10,000,000 fully executed, passed and settled, with nothing remaining to be done, and it is therefore held to be subject to taxation as a mortgage for $10,000,000. The Kings County Electric Light & Power Company also separately executed a mortgage to secure the same bonds, and it was also asked whether this mortgage must also be stamped or whether the two mortgages be treated as one, both being given to secure the same loan. The commissioner decided that the mortgage executed by the Kings County Company is subject to the same taxation as the one executed by the Edison Company. Under this ruling it is stated that the Edison Electrical Illuminating Company will have to pay a stamp tax of $5000.

ELECTRIC POWER FOR THE THIRD AVENUE SYSTEM.—On Monday last the Third Avenue Railroad Company began work preparatory to installing the underground conduit system on its lines. Ducts for the feeders are now being laid on Third Avenue, south from 124th Street, in trenches dug alongside both the up and down town tracks. The number of ducts will vary from twelve to thirty-four or more at different parts of the line. McRoy conduits and cement-lined pipes manufactured by the National Conduit & Cable Company are being used in the work. The entire system of the Third Avenue company will be equipped with electric power. The roads to be changed over are the Third Avenue, the 125th Street and Amsterdam Avenue, the Forty-second, Manhattanville & St. Nicholas Avenue, and the Dry Dock, Battery and East Broadway lines. The two last named are now operated by horses. The present cable conduits on the Third Avenue road will be used for the electric system, but new rails will be laid. These will be 60-foot 7-inch girders, made by the Johnson Company. On the other lines entirely new construction will be carried out, 9-inch 60-foot girder rails being used. The reason that only 7-inch rails will be laid on Third Avenue is because of the height of the yokes in present use, which will not permit of a higher rail being used. The electrical system to be adopted will be similar to that used by the Metropolitan Street Railway Company on its various electric lines. That is the most definite information that can be given at the present time regarding the electrical equipment, as the contracts have not yet been made. The large power house on the Kingsbridge Road will be equipped with modern apparatus, which will generate alternating currents. These will be transmitted to sub-stations at various points on the system and transformed to direct current for the operation of the cars. Just what apparatus, the number and size of units, etc., will be installed at the main and sub stations has not yet been determined upon, as the contracts have not yet been submitted. The situation may seem to many to be a peculiar one. The Third Avenue Railroad Company has determined to adopt electric power, and has actually begun the preliminary work with this end in view, but has not yet even asked for bids on the equipment. The plans are in the hands of the engineers, however, and will soon be ready to be bid on. The work of changing over to the electric system will be carried on as rapidly as possible; the laying of the rails on the Third Avenue line will immediately follow the duct work. The installation of the conduit system on the Dry Dock and other lines will commence at once and be carried to completion as quickly as possible.

BUFFALO AND NIAGARA FALLS NOTES.

IT IS HOPED that the Urban flour mill will be ready to start up with electric power before the end of the month. Since every other mill besides some other concerns are waiting to see how this venture comes out it is very essential that a good job shall be made of the work.

THE MANAGERS of the Automatic Telephone Company are not yet prepared to push the invention in this city, though they are doing well elsewhere. They are at present content with enjoying a little "family" sort of an exchange, with the wires connecting the offices of the leading members of the company, who are mainly lawyers.

USELESS LIGHTING.—The Buffalo city authorities are at loggerheads over the disposition of the arc lights that are located on the outlying parts of the city. Several years ago the land speculators secured a lot of lights in the uninhabited sections of the city, and they are still illuminating the bare fields. An agitation has been started in favor of moving them farther in toward the heart of the city, where they will do more good.

THE BELL TELEPHONE COMPANY is spending a large amount of money in burying the wires even at points in the city far removed from the business centre. A gentleman, in speaking of the policy of the company in this regard, expressed admiration for the enterprise shown, but was of the opinion that it did not help pile up dividends. He regards the popular clamor against overhead wires as very unwise, as it necessitates high charges.

THE CANADIAN NIAGARA POWER FRANCHISE.—Speculation over the probable course of the Niagara power authorities in regard to the Canadian franchise has not been put at rest by the payment last week of the $12,500 rent that had been allowed to lapse so long. It is claimed that the franchise has now run out on account of the failure of the Canadian branch of the company to go ahead with the work. Secretary Rankine came here from New York this week, and was in consultation with local members of the Canadian company, but they refused to talk on the question beyond saying that there would be developments soon. The franchise stipulated that the Canadian company should have 10,000 developed horse-power now and water connection for 25,000 horse-power. Some time ago the company applied for an extension of eighteen months, and may have obtained it.

ST. LOUIS NOTES.

ANOTHER STREET RAILWAY FRANCHISE measure was introduced into the House of Delegates at last Tuesday's meeting. The road is called the Clifton Heights & Oakland Railway, and is to cover the southwestern district of the city and connect with a county road, to be secured by franchise later.

PROPERTY OWNERS along the route of the proposed new extension of the Lindell Railway are preparing to take into court the question of the validity of the franchise recently granted by the Municipal Assembly and signed by the mayor. The points of controversy will be made upon laws which, it is held, are in direct conflict with the new line. At the head of the contesting party is some of the best legal talent in the city.

A SUIT has been filed against the St. Louis Underground Service Company, the Citizens' Electric Light & Power Company, the National Subway Company of Missouri and the Kinloch Telephone Company by two prominent citizens. They ask for the production of certain books and the appointment of a receiver for the St. Louis Underground Service Company. The suit grows out of a controversy over some stocks.

THE CASS Avenue and Fair Grounds Railway Company applied to the Circuit Court last Tuesday for an injunction restraining the St. Louis & Suburban Company from operating over its tracks. The route was granted the Suburban by the Municipal Assembly April 5, 1898. The Cass Avenue road

objects to it. It is also charged that in granting permission for the loop the Municipal Assembly violated the Julian law, which provides that when municipal street franchises are granted they shall be bid for and given to the highest bidder. It is claimed that this was not done in the case of the Suburban road.

Washington Notes.

FOUR SUITS for injunction have been brought against the Chesapeake & Potomac Telephone Company within the past week. A bill in equity has been filed by Mr. George C. Altemus, who seeks to prevent the removal of a telephone from his establishment in the city, which the company has threatened, although he has offered to pay the price fixed by Congress as the yearly rental of a telephone in the District. Three other suits were filed on November 4 in the Supreme Court of the District of Columbia. The petitioners are James and Lewis Holmes, doing business at First and E Streets; Fenton A. Denison, trading as Denison & Co., at No. 206 Tenth Street, and Collins & Gaddes, at No. 511 Eleventh Street.

GAS EXPLOSION AT THE CAPITOL.—On Sunday afternoon last an explosion of gas occurred in that part of the Capitol occupied by the United States Supreme Court, causing much damage. This accident is a strong argument against the use of gas and favorable to the adoption of electric light in such buildings, where there is much valuable property in jeopardy. Apart from the danger of gas explosions the products of combustion from the gas jets are injurious to books and fabrics, and in time produce a dingy appearance to the surroundings. These objections are entirely removed by the use of electric light. There are now two electric light plants in the Capitol, but the use of gas in halls and similar places is yet continued.

AMERICAN LAMPS IN JAPAN.—The American consul at Hiogo writes to the State Department that he has received a letter from K. Ikeda, president of the Kobe Electric Light Company, in answer to the consul's inquiries relative to electric light supplies. The company, the letter states, formerly used only the Edison lamp, but in 1894 changed to English and German lamps, in consequence of the latter being cheaper; but it recognizes the superiority of the American or Edison lamp, and says that it is desirable to use lamps requiring the least amount of power. Apparatus for testing lamps is now being installed, which may disclose that the company should discard the cheaper English and German lamps, and again use the Edison.

Chicago Notes.

ALL OF THE BRIDGES across the Chicago River in the business sections of the city are now operated by electric motors. The Adams Street bridge was recently equipped with electrical apparatus, and this was the last of these structures to be so outfitted.

A JAPANESE ELECTRICAL FRANCHISE.—It is reported that the Siemens & Halske Company of America has received a proposition from the Japanese Government to form a syndicate to develop electrical enterprises in Japan, such as electric railways and lighting plants, and that the matter is now under consideration by the Chicago company. The franchise, it is stated, will be exclusive, and one of the most valuable ever granted to one syndicate or corporation. The Elkins-Widener syndicate, of Philadelphia, it is stated, will be interested in the Japanese syndicate if it is formed. The syndicate, it is reported, will have a capitalization of about $10,000,000.

Mexican Notes.

PRESIDENT PORFIRIO DIAZ has promised to visit Monterey the latter part of this month, and extensive preparations are now being made for his reception and entertainment. The electric light company is wiring all of the public plazas and buildings, and the electrical illumination upon the occasion of the presence of the distinguished visitor will be exceedingly beautiful.

THE WORK of introducing electric traction on the street-car system of the city of Mexico is making good progress. The first portion of the system to be changed over to electricity will be the line to Guadaloupe and the line to San Angel, by way of Chapultepec, Tacubaya and Mixcoac, embracing in all about 26 miles of track. An entirely new roadbed is being constructed and new 85-pound rails will be laid. Three different styles of trolley poles will be used. For double track outside of the city gates the centre pole with double bracket will be used. Inside the city gates both the side-pole system, in which the trolley wires is suspended from wires strung across the street from pole to pole, and the single-bracket pole will be used. The poles will be 28 feet high. They will be all iron and made by the National Tube Works, of McKeesport, Pa. The power house will be of iron and brick. There will be three boilers, of the Babcock & Wilcox type, and three McIntosh & Seymour engines. The nominal horse-power of the plant is calculated at 1200. The boilers are being built in Glasgow, Scotland. The General Electric Company will furnish the electrical plant, the cars being equipped with 70-hp motors. The J. G. Brill Company, of Philadelphia, is now building thirty cars for this road.

Pacific Coast Notes.

THE OREGON AUTOMATIC TELEPHONE COMPANY recently filed articles of incorporation in Portland, Ore. The incorporators are H. A. Heppner, Carl Barkman and Thomas K. Muir. The capitalization is $25,000.

TRANSMISSION PLANT.—The right of way has been secured to erect a dam on the Sandy River in Oregon by persons who claim to be about to install an extensive electric and manufacturing plant. The location is within transmission distance of Portland, Ore.

PHILIPPINE ISLAND SUBMARINE LINE.—It is reported that a cable and telephone line has been laid from Manilla to Cavité. Major Thompson, chief of the United States Signal Corps, fearing that the land lines would be tampered with by the natives, directed Captain Kenna to lay out a route for a cable. They finally tried the experiment of laying an ordinary insulated copper wire under the bay. The wire was spliced to a cable to carry it out beyond the surf, and then laid across to Cavité. Off the latter place a circuit was made into Bakor Bay to avoid the shipping, and then another splice to a cable was made. It is claimed to be the only line of the kind in use.

Canadian Notes.

THE STATEMENT of the Montreal Electric Street Railway Company for the last year shows the net profits to have been $601,704.18, against $507,885.60 for the year previous. After paying a 10 per cent. dividend, $138,000 was carried over to the rest account.

A BY-LAW providing that the Toronto Electric Street Railway shall have vestibules on the rear of the cars has gone into effect, but the vestibules are not in evidence, nor does there appear to have been any effort on the part of the company to provide them. The Toronto civic authorities are determined to test their power in the matter, and City Solicitor Caswell promptly laid information against the company for breach of the by-law. The case will come up for trial.

THE OFFICIAL ANNOUNCEMENT has been made by the Quebec, Montmorency & Charlevoix Electric Railway Company that it is proposed to equip the road running from Cape Tourmente, Quebec, with electric power, and to construct an independent branch to Montmorency Falls. The estimated cost of improvements is given as $330,000, and when completed the system will comprise over 60 miles of electric railway. The president of the company is H. J. Beemer. The shareholders of the Quebec, Montmorency & Charlevoix Railway and of the Quebec Electric Railway on Wednesday week had their first general meeting since the amalgamation of the two companies, to authorize the board of directors to issue debentures to the amount of $1,500,000, bearing 5 per cent. interest, redeemable in twenty-five years and secured by a first mortgage on all the properties of the company. Since the companies were amalgamated the gross receipts have been $79,006, and the expenses $33,647, leaving a net balance of $45,559.

NEW CALCIUM CARBIDE FURNACES.—For the past two weeks there has been an experiment going on in this city which has now developed into an industry. It is the manufacture of calcium carbide for the production of acetylene gas by means of a new, yet simple and effective, method. The inventors of this new scheme are Messrs. H. Lamoth and J. W. McRae, of Ottawa. The new idea is in the furnaces which are to be used in the manufacture of the carbide. The furnace consists of two electrodes, one suspended from above and the other placed on the ground. The two are connected by means of carbon pencils, which form an arc producing sufficient heat to melt the coke and limestone which are piled around these electrodes, and form it into calcium carbide. It is the intention of the promoters of this new industry to erect a plant containing about forty of these furnaces, which will be kept running sixteen hours per day. The carbide is produced for $60 per ton wholesale, and the factories now making this product throughout Canada are unable to keep up with the orders for this product. By operating their present plant the inventors expect to be able to turn out about 10 tons of carbide per day.

South African Notes.

THE RUNNING OF A 10,000-VOLT PLANT.—The generators of the power transmission system of Moodie's Gold Mining & Exploration Company, Limited, recently ran for over eighty-eight days continuously without any interruption whatever. During this time there were partial losses of load (due to line fuses going) amounting in all to only twenty-five minutes.

LIGHTING AND TRAMWAY CONTRACTS.—There has recently been a little more activity than usual in the electrical business. The town of East London has concluded contracts for a lighting system and also for a tram line, the total to be outlaid being about $200,000. Bloemfontein has also decided at last to put down an electrical plant, and the work in connection with the Grahamstown Exhibition is in progress. All of these undertakings are in the hands of Johannesburg firms.

PROPOSED ENLARGEMENT OF JOHANNESBURG LIGHTING WORKS.—The Town Council of Johannesburg proposes to raise £150,000 ($750,000) on debentures for the purpose of increasing its lighting plant. The town possesses two lighting systems, one electrical, the other gas. It is proposed to extend both of these and to give further facilities for the use of gas for cooking purposes. Since the town took over these undertakings in April, 1895, the dynamo capacity has been raised from 120 to 675 kilowatts, while that of the gas plant has been more than doubled in the same time. In addition to the town plant there is, of course, a very large amount of lighting done by private concerns.

French Notes.

ELECTRIC TRACTION AT VINCENNES, SEINE.—The question of substituting electric traction by the overhead system for the compressed air on the lines through the Vincennes woods is now up for consideration.

ELECTRIC TRACTION IN FRANCE.—France is next to Germany in the number of electric railway lines now in operation. During 1897 her mileage increased some 73,000 miles, making a total construction for one year in France almost equal to the total existing mileage of England. Seventy-two companies use the overhead trolley, eight use underground conductors and thirteen operate with storage batteries.

AN IMPROVEMENT IN TROLLEY WHEELS.—This invention is intended to guard against the jumping of the trolley wheel from the wire, which occurs with such annoying frequency at switches and sharp turns where the wire is necessarily out of line with the centre of the track. Instead of mounting the wheel rigidly at the end of the pole a spiral spring connects the two, allowing the wheel to follow the many irregularities of the wire, no matter in what direction they occur, without causing too much pressure between the wire and the flanges of the wheel.

THE MACHINE SHOPS OF THE DECAUVILLE COMPANY.—The new Decauville Company has recently built some new shops for electro-mechanical work, and is now able to fill orders for generators and motors of all

sizes, or to contract for complete electrical installation, transmission of power, traction work, etc. Among the installations made by this company is that at Sondière de la Madeleine, near Saint-Nicholas du Port (M. et M.), which has been found very satisfactory. Also a number of motors were put into the foundries and smelting works at Pont-à-Mousson, and both generators and motors for Darblay & Sons, Essonnes. A recent order received by the Decauville Company was from the Norman Electric Light Company, of Rouen, for a three-wire system electric light generator of 800 horse-power.

AN ELECTRIC PROTECTIVE DEVICE FOR LINEMEN.—A new arrangement has been invented for the protection of linemen at work. The object of this instrument is to provide a path for the current which will conduct it off the line before it reaches the lineman in case the current is thrown on to a dead line by mistake while it is undergoing repairs. For overhead work it is composed of six hooks connected together in two groups and carried on an insulated handle, with which they may be fastened to the wires without the aid of a ladder; each group of hooks is grounded through a flexible conductor ending in a metal spike, to be stuck into the ground. For underground work the hooks are replaced by clamps which have insulated handles kept apart by a strong spring, and which are grounded as before through a spike and flexible connection.

ELECTRIC TRANSMISSION OF POWER.—An application has been made by a corporation for a franchise to permit the erection of a power station on the banks of the Loire. The enterprise contemplates developing near the Villerest paper mill 10,000 gross horse-power, to be transmitted for light and power purpose to Roanne and its environs. There is at present a considerable use made of steam power in this district at a cost of operation varying from 200 to 500 francs and over per year on a basis of ten hours per day and 300 days per year. Leaving out of consideration the possible use of current for electro-chemical purposes, and leaving out also the possibility of transmitting power to Charlière, Regny, Amplepuis, Thizy, Cours, etc., it is practically certain that with cheap power in the district considered new manufactures and industries would be attracted and the old ones greatly developed. This could be done successfully by selling power at from 300 to 150 francs per horse-power per year (10 hours per day and 300 days); this would be equivalent to 15 centimes (3 cents) per kilowatt, and would effect a saving to the consumer of 25 to 50 per cent. in the cost of his power. In addition, there are not far from a hundred villages which would all use electric light, the advent of which is earnestly desired by the inhabitants. Many municipalities and manufacturers are already in line, and need nothing but proposals to become customers.

A TELEPHONE LINE ALONG THE MEDITERRANEAN COAST.—It has been decided to establish telephonic communication between Marseilles and the towns along the coast. The great importance and practical value of this line to both public and private business in these cities is very evident; it brings them into communication not only with Marseilles, but with all the other cities with which Marseilles is connected and with Paris in particular. There was a meeting on April 25 between the representatives of the various cities concerned and a telegraph superintendent, M. Frouin, ministerial chief of the office of telegraphic communication, who was especially appointed to consider the matter by the Minister of Posts and Telegraphs. At this meeting it was agreed to issue bonds for 350,000 francs on the credit of the cities and towns concerned in the enterprise, these bonds to bear interest not to exceed 3½ per cent., together with provision for a sinking fund, which will wipe out the debt in five years. At the rate of interest specified the yearly interest account is 12,650 francs, which will be divided as follows: Marseilles, 2000 francs; Toulon, 3000; Hyères, 300; Fréjus, 300; Menton, 250; Draguignan, 250; Grasse, 200; Antibes, 200; Saint-Raphael, 200; Vallauris, 150; Beaulieu, 150; Villefranche, 150. It is readily understood that these interest charges will decrease from year to year in proportion to the receipts with the operation of the sinking fund provision. Every city is at liberty to advance the necessary capital directly from its treasury.

General News.

THE TELEGRAPH AND TELEPHONE.

OWENSBORO, KY.—The Cumberland Telephone Company contemplates the erection of a modern exchange building here.

BOSTON, MASS.—The People's Telephone & Telegraph Company, Worcester, has been incorporated. J. L. Currier is president; F. W. White, treasurer; capital, $150,000.

HARRISBURG, PA.—The Pennsylvania Telephone Company has let the contract to extend its line from New Tripoli to Slatington by way of Garmansville, Sagersville, Dibertsville and Slatedale. The new line will be in operation by December 1.

RICHMOND, KY.—A scheme is on foot to buy up and consolidate all the local telephone lines of Central and Eastern Kentucky, numbering about twenty-five, extending as far north as Maysville and south to Somerset, into one system. Capitalists of this city are at the head of the scheme.

NEW YORK, N. Y.—The Fowler Switchboard & Telephone Company, of New York City, has been incorporated to manufacture telephone and other electrical fixtures. The capital is $5000. Directors, John T. McRay, of New York City; Samuel B. Fowler, of Brooklyn, and L. Victor Heckles, of Brooklyn.

SANTIAGO DE CUBA.—An overland telegraph line from Guantanamo to Manzanillo by way of Santiago has been ordered constructed by the United States Signal Corps. The line will be used for the transmission of official government dispatches, but it is stated that commercial business will also be accepted.

BOSTON, MASS.—The Mexican Telephone Company has expended $33,000 in establishing metallic service, which amount has been paid out of the earnings. The company is increasing its rental per subscriber from $75 to $125, although the metallic service is optional. It, however, reports a gratifying demand for the service at the higher price.

NEW PHILADELPHIA, OHIO.—The Tuscarawas Home Telephone Company, with headquarters at this place, and a capital stock of $75,000, has been incorporated by J. S. Bailey, F. W. Bainbridge, J. W. Yeagley, O. S. Welty and J. H. Mitchell, to operate a telephone system between New Philadelphia, Canal Dover, Uhrichsville, Dennison, Canton, Carrollton, Cadiz, Cambridge, Coshocton, Millersburg, Wooster and neighboring villages.

BOSTON, MASS.—The instrument report of the Bell Telephone Company for the month ended October 20 shows the following: Gross output 33,639, an increase of 10,508 over October last year; net output 21,816, an increase of 5830. Since December 20, last year, the gross output was 278,363, an increase of 92,487, and the net output 158,281, an increase of 48,658. The total number of instruments outstanding October 20 was 1,077,420, an increase as compared with the number at the same period last year of 193,930.

SAN FRANCISCO, CAL.—In a recent interview with Mr. Heinrich Hofmeister, director of the German telegraph system and superintendent of the cable system at Emden, that gentleman gave some interesting facts concerning the telegraph service in his country. He stated that the greatest difference between the service there and the telegraph service in this country is that the Germans do more for the small towns and villages. In Germany the mails, the telegraph and the telephone are combined in one department, which is in charge of Dr. Von Stephan, whose principal aim is to secure the most perfect system at a minimum cost. The telegraph tolls in Germany compared with those in this country are very much lower, the charge for a 10-word telegram to any part of the Empire being about 5 cents of our money. In the telephone service 25 cents for five minutes' conversation is charged, irrespective of the distance, which is not taken into account as in this country. Individual telephone subscribers pay 150 marks or about $36 a year for the use of the telephone. Overhead wires were abolished in Germany long ago, not only in cities, but through the Empire. Cables containing seven copper conductors constructed like submarine cables and encased in iron pipes, are used on the underground work. Germany, Mr. Hofmeister said, is one gigantic spider web of underground cables. Main lines radiate from Berlin to the uttermost edge of the country, and these radiating lines are joined together at regular intervals. Occasionally wires are strung on poles in the country, but two poles are used, instead of one, to support the cross arm. Porcelain insulators are used in overhead work in place of glass.

ELECTRIC LIGHT AND POWER.

CLARENCE, MO.—At a special election held here it was voted to issue $5000 of electric light bonds.

WICHITA, KANS.—The city authorities are considering the question of establishing an electric light plant.

CHARLEROI, MICH.—A vote will be taken here on the proposition to bond the city for $10,000 to purchase the electric light plant now operated by private capital.

PEORIA, ILL.—The Diamond Motor Company has been organized in this city, with a capital stock of $30,000. The incorporators are E. Couck, W. Reyle, A. Fink and G. Scheefer.

IRONTON, OHIO.—The electric plant was burned to the ground recently. The damage amounts to about $8000, which is partly covered by insurance. The plant will be rebuilt at once.

EDWARDSVILLE, ILL.—The plant of the Edwardsville Electric Light & Power Company was recently completely destroyed by fire, entailing a loss of $40,000. Immediate steps have been taken to rebuild.

GREENPORT, L. I., N. Y.—The Greenport Electric Light Company is considering the advisability of having a new electric light plant established in this village in place of the old one, which is sadly in need of repairs. A new boiler will be put in at once.

BENTON HARBOR, MICH.—The City Council of Benton Harbor has closed a contract with the Benton Harbor & St. Joseph Electric Light Company for a term of five years. The contract calls for 1200-cp arc lights, and the price paid for forty lights for the five years is $14,000, making a rate of $70 per electric light per year.

MACON, MO.—The Trans-Mississippi Electric Light & Power Company has been incorporated with a capital stock of $30,000. Col. F. W. Blees, J. F. Schaefer, of Kansas City, and Charles E. Roel, of St. Joseph, are the directors. The company was organized for the purpose of establishing and managing electric light and power stations.

ALLEGAN, MICH.—The Kalamazoo Valley Electric Company, recently organized, has begun the construction of a dam in the Kalamazoo River 4 miles from here, to cost $125,000, and which, it is expected, will develop 13,500 horsepower. Four large water wheels will be put in, and the electric power generated will be distributed to Allegan, Kalamazoo, Plainwell, Otsego and other towns for lighting and power purposes. The works will be in operation next spring.

CHARLESTON, W. VA.—The Edison Junior Electric Light & Power Company, of New York City, has been incorporated here for the purpose of manufacturing, selling, licensing or otherwise dealing in electric storage batteries and electrical appliances, etc. Capital subscribed, $100, with the privilege of increasing the same to $500,000 in all. The shares are held by Thomas A. Edison, Jr., Valentine Robinson, H. C. Hepburn, E. A. Drake, C. S. Henry, R. M. Jordan, J. G. Batterson, Jr., and F. J. Stone, all of New York City.

UNADILLA, N. Y.—The Standard Light, Heat & Power Company has been incorporated with a capital of $600,000. The company will furnish electricity for the villages of Unadilla, Gilbertsville and Otego, Otsego County; Sidney and Franklin, Delaware County, and Bainbridge and Afton, Chenango County. The directors are Henry G. Canfield, Samuel E. North, J. Fred

Sands and Daniel R. Buckley, all of Unadilla. The company has secured the paper mill plant near Sidney, and the Crookerville mills above Unadilla is also incorporated in the same concern. The company already holds the lighting franchise for Bainbridge, and is getting estimates on water wheels and machinery for its central station.

The Electric Railway.

NORFOLK, VA.—The Port Norfolk Electric Railroad, valued at about $500,000, has been sold, it is stated, to New York parties.

DAYTON, OHIO.—The Dayton & Xenia Traction Company has filed papers of incorporation at Columbus. The capital stock is $300,000. The road will be built over private right of way at once. J. M. Wilson is to superintend the work.

CEDAR FALLS, IA.—J. F. Cass, of Sumner; L. S. Cass and C. J. Fossilman, of Waterloo, have bought the Cedar Falls street car line and will change it to an electrical system, running in connection with the Waterloo & Interurban Railway. Work will commence at once.

FRANKFORT, KY.—The officers of the Frankfort Street Railway Company have served notice on the City Council that if compelled to lay new rails on the streets of the city where brick streets are being put in they will be compelled to go out of business. The Council lately passed an ordinance ordering the new rails put in.

COLUMBIA, N. Y.—The Columbia Traction Company has been incorporated under the laws of New Jersey, with a capital of $100,000. The proposed road is to connect Hudson and Philmont. The officers are: President, Franklin G. Simmons; treasurer, William C. Allen; secretary, E. F. Foote. Mellenville and Claverack will also be connected.

HAMPTON, VA.—The transfer of the property of the Newport News, Hampton & Old Point Company to the Newport News & Old Point Railway & Electric Company has been accomplished. The exact sum involved in the deal has not been made public, but it is known that with the extensive improvements contemplated it will exceed $1,000,000.

STREATOR, ILL.—The Streator Electric Railway was sold recently by a master in chancery from the United States Court at Chicago. It was bid in at $14,000 by C. C. Barr. Mr. Barr was the principal stockholder in the road. The road runs to the four corners of Streator, and it now is apt to go to the owners of the cross country line between Streator and Ottawa.

LINCOLN, ILL.—The City Council has granted the Lincoln Electric Street Railway Company an extension to forty years, with the provision that unless the company shall construct a certain loop, covering nearly two miles of territory in the neighborhood of Lincoln University, within twenty-four months, the rights of the franchise shall become void and will be forfeited.

JOHNSTOWN, PA.—A new trolley line from this city to Geistown, Scalp Level and Windber is assured. A charter has been granted to the Johnstown & Somerset Traction Company, which will build and operate the road. The incorporators are Charles S. Price, David Barry, M. L. Woolf, H. H. Weaver and Frederick Krebs. The road will open up a large section of territory.

BOSTON, MASS.—The Railroad Commissioners have authorized the Mystic Street Railway Company to issue $80,000 twenty-year 5 per cent. bonds for funding the floating debt of the company incurred in construction and in the purchase of the Arlington & Winchester Street Railway Company. The bonds will also refund the floating indebtedness of the Arlington & Winchester Railway.

CLEVELAND, OHIO.—The City Council recently passed ordinances imposing a 4-cent fare on the big and little consolidated railway systems. Both companies have begun proceedings in the United States Circuit Court, asking for an injunction preventing the city from carrying the ordinances into effect. A temporary restraining order was issued, good until December 1, when the case will be heard.

KENOSHA, WIS.—The Milwaukee, Racine & Kenosha Street Railway Company has succeeded in getting the Common Council to grant it a franchise. The company will at once begin the construction of the road through the city, but will meet with great opposition by many of the property owners along the proposed route, who severely criticise the Council for its liberality toward the company.

PITTSBURG, PA.—At one time Pittsburg was considered a great racing city, and the Monongahela Traction Company, which is now building a road along the south bank of the Monongahela River to McKeesport, intends trying to win back that reputation. The company has leased ground at Thompson station, on the Pittsburg, Virginia & Charleston Railroad, and proposes to construct a mile track there.

PITTSBURG, PA.—The board of directors of the Consolidated Traction Company has declared a 3 per cent. dividend on the preferred stock, payable November 15, 1898. The earnings of the company show a steady increase. Receipts for the six months ending September 30, 1898, as compared with the corresponding six months in 1897, make the following showing: 1898, $1,089,734.10; 1897, $948,230.87; increase, $141,503.23.

COLUMBUS, OHIO.—Judge Badger, of the Franklin County Common Pleas Court, has issued an order of foreclosure against the Columbus Central Street Railway at the instance of the Cleveland Savings & Trust Company, which holds a mortgage for $1,500,000 on the property. George W. Worthington, of Cleveland, will conduct the sale. A reorganization committee will purchase the plant and extend it over many streets not now covered.

BOSTON, MASS.—The Boston & Maine Railroad corporation is to equip its Portsmouth & Dover branch, about 10 miles in length, for electrical operation. It is probable that the change from steam to electricity will be made early next summer. The power for this line and for the Portsmouth, Newcastle & Rye Electric Street Railway line will be furnished from a power house on Noble's Island. The cost of equipping the line with electricity is expected to be about $12,000.

PHILADELPHIA, PA.—An ordinance has been introduced in Camden City Council to grant a franchise for a terminus in that city of an electric railroad between Philadelphia and Atlantic City. The tracks are to be elevated within the city limits at a height of 14 feet in the clear and 20 feet above steam railroads. The ordinance contains the names of Walter N. Boyer, Frederick S. Dickinson, Lewis W. Moore and Daniel Caldwell as applicants for the franchise. These are said to be Philadelphia capitalists, and it is reported that there is a capital of $3,000,000 back of the scheme.

NEW BRUNSWICK, N. J.—The Brunswick Traction Company, which controls all the trolley lines in Middlesex County, and also lines in Somerset and Union counties, has been merged with the New York & Philadelphia Traction Company. Judge Gottfried Krueger, of Newark; Andrew Radel, of Bridgeport, and E. H. Radel, of New Brunswick, have purchased a controlling interest in the New York & Philadelphia Company. J. Blair MacAfee, vice-president of the New York & Philadelphia Company, will retain his office, and his company will be operated under the direction of the Brunswick Company.

NEW YORK, N. Y.—In a recent issue of a financial exchange it was stated that at the annual meeting of the Central London Railway an explanation was given to those present in reference to the letting of contracts for apparatus and material to American concerns. The company states that the contracts for carriages, locomotives and machinery were given to American firms because the more extensive use of electric traction in the United States has brought the manufacture of apparatus to a higher state of perfection and at much lower cost. "Their tools and manufactured machinery," the report states, "are much in advance of ours, as might be expected when the small amount of electric traction construction in England is considered. The difference in the cost of production here and in America is considerable, and as it is desired to build and fit the line on the very latest and best principles, no resource was left us but to approve of the electric traction company's action."

NEW YORK, N. Y.—A peculiar accident occurred on the line of the Staten Island Electric Railroad Company, near St. George, on the night of November 2. A car going down a hill blew out a fuse, and in order to replace the burned-out fuse with a new one the trolley pole was pulled down from the wire, thus leaving the car in darkness. The motorman of the car following, not being able to see the disabled car, descended the grade at a rapid rate, and a collision resulted before the brakes could be effectively used. There were thirty-seven passengers on the second car, and they were hurled in a heap in one corner, while the windows of both cars were broken and the platforms wrecked. A third car came along, and the motorman, not being aware of anything unusual ahead of him, came down the hill and ran into the wreck of the two cars, and the fourth car met disaster in a like manner. There was much excitement for a time, but fortunately no one was seriously injured, although the passengers received a good lively shaking up. The four disabled cars were towed to the repair shop at New Brighton, after a delay to traffic of over an hour.

Personal Notes.

MR. FRANK NICHOLS PHILLIPS, second son of Mr. Eugene F. Phillips, and president of the American Electrical Works, of Providence, R. I., is to be married on November 15 to Miss Edith Remington Peck. The young couple have the best wishes of the electrical fraternity for a future full of happiness and prosperity.

MR. WILLIAM J. CLARK, general manager of the railway department of the General Electric Company, has, according to information from Washington, been requested by Secretary of War Alger to examine and put the finishing touches on the report of the late Colonel Waring in reference to the sanitation of Havana and other Cuban cities. Mr. Clark is an authority on Cuban affairs, having spent considerable time in that part of the world, and this invitation on the part of the United States Government is a well-merited recognition of his ability to pass upon matters of such vast importance. Mr. Clark went to Cuba in connection with transportation matters, and while there he and Colonel Waring were together much of the time. Colonel Waring gave Mr. Clark much information about his work, and explained his plans, and it was in this way that the latter gentleman became familiar with the matter. It was on account of his knowledge of the subject that Mr. Clark was chosen to complete the work left unfinished by the untimely death of Colonel Waring.

Obituary Note.

MR. CHARLES H. SUMMERS, chief electrician of the Western division of the Western Union Telegraph Company, with headquarters in Chicago, died suddenly of heart failure in San Francisco on November 2. Deceased was a native of Kentucky, and began his telegraphic career in 1854. He was very widely known in the telegraph field.

Trade and Industrial Notes.

MR. WILLIAM LINDSAY, formerly with the F. M. Pierce Engineering Company, of New York City, has recently joined the local selling staff of the C & C Electric Company, succeeding Mr. C. H. Kirkland, who has resigned.

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, Boston, Mass., reports that it has a large amount of work on hand, and is behind its orders at the present time. It reports that it is now building for unfilled orders governors to control water wheels aggregating about 18,000 horse-power.

DIRECT MOTORS.—The Crocker-Wheeler Electric Company, 39 Cortlandt Street, New York, in Bulletin No. 5 describes small sizes of very slow motors for direct attachment to machinery. Every detail of these small machines is very well illustrated and described, and dimensional diagrams are also given.

MR. CHARLES F. CROSELMIRE, platinum refiner, Newark, N. J., returned from Europe on October 1, but went back again on October 20 on the steamer "Fuerst Bismarck." Mr. Croselmire's destination is the mountains of Russia, where he intends to make his platinum contracts for the coming year.

THE WESTERN ELECTRIC COMPANY has distributed a bulletin giving a full description and price list of the Western Electric non-sparking brushes. These brushes are said to be very satisfactory in eliminating the sparking at the commutator. Upon request a copy of the bulletin will be sent to any one who has not received one.

THE WALKER COMPANY, according to a Cleveland dispatch, has just finished the first of the eleven carriages for the Buffington-Crozier disappearing guns, for which it was awaraded the contract last April. A test was made on November 1. The carriage weighs 107,000 pounds, and the gun, which is an 8-inch rifle, 32,000 pounds.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is erecting the steelwork for a generator room and an engine room for the United Gas Improvement Company, Waterbury, Conn. The roofs are to have steel trusses supporting the roof covering of corrugated iron lined with the Berlin Iron Bridge Company's patent anti-condensation fireproof lining.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., reports an excellent business this season. Notwithstanding the fact that the facilities for turning out Columbia lamps have been increased 25 per cent., the company is compelled to operate its factory three nights each week in order to handle the volume of business which has been coming in this fall.

THE WESTERN ELECTRICAL SUPPLY COMPANY, 10 and 12 North Ninth Street, St. Louis, Mo., is distributing in the trade, with its compliments, a blank duplicate order book. Any order sent to this company will receive prompt and careful attention. This method of facilitating the work of making out orders should bring to the company an extra amount of business.

THE ROBB ENGINEERING COMPANY, Limited, of Amherst, N. S., has issued a little pamphlet entitled "Steam." The contents of the pamphlet are devoted in the main to a description of the Robb-Armstrong engine, which is built by this company, and the Mumford improved, the Monarch and other types of boilers. The engines of this company are excellently adapted for the driving of electric generating machinery.

THE AMERICAN ENGINE COMPANY, Bound Brook, N. J., has just shipped a complete 25-kw direct-connected plant to the Porvenir sugar estate, Santo Domingo. This, it is said, will be the first direct-connected plant installed on the island. The same company is also about to install a 35-kw complete plant of its own manufacture in the Grenoble apartment building, Fifty-seventh Street and Seventh Avenue, New York City.

MR. WILLIAM D. PACKARD, of the New York & Ohio Company, Warren, Ohio, has designed a new form of fuse wire holder of the style commonly used for the protection of outdoor transformer primaries, the patent on which, No. 613,594, was issued November 1. The holder embodies a transparent or translucent bulb by which the condition of the fuse may be seen and means for replacing the fuse without any tools whatever.

MESSRS. EDWARDS & CO., 144th Street and Fourth Avenue, New York, have brought out a new bellstriking device for church bells, village fire alarms, etc. It is said to be less expensive than other apparatus of this kind and satisfactory in operation. Two towns are now being equipped with the device. The Edwards Company is in a position to furnish the full equipment for the system and install the same.

MR. J. P. WILLIAMS, 39 Cortlandt Street, New York, has received the sole agency for New York State and New England for the sale of the Morris constant-potential, direct-current enclosed arc lamp. It is stated that this lamp has given the utmost satisfaction wherever it is used. It is made for use on all standard constant-potential circuits, of 110, 220 and 550 volts. These lamps consume five amperes and have a life of 100 hours, the length of the lamp over all being 30 inches.

THE MUELLER ELECTRIC COMPANY is the name of a company just organized by Messrs. William Mueller and H. J. Schuette, with headquarters at 713-715 Burling Street, Chicago, Ill. Mr. Mueller, who is already well known in the electrical trades, assures his customers that their orders will receive prompt attention, as the new company has an excellent corps of employees. The Mueller Electric Company has issued a new catalogue, a copy of which can be had on application.

PAPER FRICTION WHEELS AND PAPER PULLEYS.—The Rockwood Manufacturing Company, 330-338 South Pennsylvania Street, Indianapolis, Ind., has just issued an illustrated price list of its paper friction wheels and paper pulleys. Paper and iron friction wheels in pairs are adapted to any class of work performed by the common spur, bevel or mitre gears, and are especially desirable where machinery is thrown in and out of gear, and for reverse motions. Friction gearing is noiseless in operation.

MOULDED INSULATION.—In the last issue of THE ELECTRICAL WORLD appeared a paragraph concerning some of the products of the Mica Insulator Company, of New York, Chicago and London, under the head of "Moulded Porcelain." This error in the title, while an obvious one, might mislead some of our readers into the belief that the Mica Insulator Company is also in the porcelain business, but it is not. The production of its micanite materials requires its undivided attention, and gets it.

THE PARIS EXPOSITION.—Manufacturers and others who are considering the advisability of making an exhibit at the Universal Exposition, to be held in Paris in 1900, may learn something to their advantage in this connection by communicating with the Franco-American Company, 163 Washington Street, Chicago. The object of this company is to arrange for space and look after the exhibits of its patrons. It claims to have had twenty years' experience in this line, and is, therefore, well qualified to conduct this important business.

PROTECTION AGAINST LIGHTNING.—One of the greatest problems which presents itself to every electric light station manager is the proper protection of electrical machinery from damage by lightning. Anything leading to a proper solution of the problem is always welcome. The Electric Appliance Company, Chicago, has just issued a special circular on Wurts lightning arresters, which embody all of the improvements to date in this class of apparatus. The circular gives some valuable hints with reference to protection from lightning.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, has just closed a contract for a switchboard of 2000 metallic lines for Lancaster, Pa., to be built on the same designs and plan as the board which is going in the exchange of the Home Telephone Company at Trenton, N. J., and which is briefly described and illustrated on another page in this issue. The company reports a noticeable increase in its orders for apparatus for the extension of exchanges, which is taken to indicate a generally healthy state of the telephone business throughout the country.

HAIR SPRINGS FOR ELECTRICAL INSTRUMENTS.—In the construction of electrical indicating instruments, the accuracy of the instrument depends very largely upon the integrity of the hair springs used. As a result of thorough and practical tests and examinations it has been shown that the hair springs made by Mr. F. N. Manross, Forestville, Conn., are among the best produced. For electrical instruments and for recording gauges, Mr. Manross makes phosphor-bronze springs, and those interested in these matters would do well to communicate with him.

VITOGEN.—In steam plants, particularly in electric light stations and power plants, the danger of scalding and burning is always present. It is always wise, therefore, to be prepared for emergencies, and some remedy should be kept at hand and immediately available to relieve suffering in case of accident. Vitogen is highly recommended for its healing properties in case of burns and scalds. It is a powder, and is sprinkled upon the parts affected, giving immediate relief and promoting healthy conditions. It is non-irritating and is antiseptic. The G. F. Harvey Company, Saratoga Springs, N. Y., manufacturer of Vitogen, has many convincing testimonials as to the healing qualities of this substance.

THE IMPROVEMENTS OF THE McEWEN ENGINE AND THOMPSON-RYAN DYNAMO.—In a description in these columns in the issue of October 29 of the exhibit of the Ridgway Dynamo & Engine Company, at the Mechanics Fair, Boston, Mass., it was stated that the inertia governor used was a modification of the Rites design. On the other hand, it is a form of the Begtrup inertia governor, the patents on which are owned exclusively by the Ridgway Dynamo & Engine Company, and which this company states to be the original and first successful inertia governor used in this country. In regard to the dynamo, it was stated that the brush holders were a modification of the reaction type, and it should be stated that this is only so in point of appearance, the modification, as there noted, differentiating it from that type and allowing of its construction independent of the Baylis patents.

FRINK'S REFLECTORS.—I. P. Frink, 551 Pearl Street, New York, in catalogue No. 32, describes Frink's patent reflectors for electric and combination fixtures for use in lighting churches, halls, banks, stores, offices, public buildings, factories, etc. The catalogue contains sixty-four pages, and is profusely illustrated with reflectors of every imaginable design. The reflectors are made of the best crystal corrugated glass, of double silver plate, coated on the back with heat and moisture proof cement, and are therefore calculated to last. Every one desiring the best distribution of light should investigate the merits of these goods. I. P. Frink produces a line of electric signs. Plain block letters of standard type of construction, ready to mount on framework or sign board, are kept in stock, and the concern will be glad at any time to submit designs and quote prices upon any style of sign desired, either in plain, block, script or fancy lettering.

THE AMERICAN ASIATIC ASSOCIATION is the title of an organization having for its object the dissemination among its members of information touching matters pertaining to trade with Asiatic countries, including China and the Philippines. Among its members are the General Electric Company, the C & C Electric Company, the Goulds Manufacturing Company, the Niles Tool Works Company, the Okonite Company, Ltd., the Pantasote Leather Company, Messrs. Charles A. Schieren & Co., the Western Electric Company, of New York; the Westinghouse Electric & Manufacturing Company, of Pittsburg, and Henry R. Worthington, of Brooklyn. The association publishes a paper called the "Journal of the American Asiatic Association," of which Mr. John Foord is editor. His address is P. O. Box 1500, New York. The possibilities of the extension of trade in the Philippines and China and other Asiatic countries, and the promising fields for enterprise which are about to be opened up in these far away lands, render the work of this association of great value and importance to its members, who are among the leading concerns in their respective lines of industry in the United States.

HYDRAULIC TOOLS.—The Watson-Stillman Company, 204-210 East Forty-third Street, New York, has been engaged for thirty years in the business of manufacturing hydraulic jacks, and any statement made by it regarding these indispensable tools may safely be accepted unquestioned. The company has just issued a seventy-page illustrated catalogue of its extensive and varied lines of hydraulic tools for railroad work. This company makes hydraulic jacks and tools for every purpose, and among the devices illustrated in the catalogue of special interest to electric railway engineers and mechanics are, besides the ordinary plain jack, the Vreeland patent transfer pit jacks, hydraulic screw punches, hydraulic "T"-rail bender, hand and belt power hydraulic wheel presses, hand-power car-axle straightening press, etc. The hydraulic rail bender has been recently added to the company's line of railroad tools, and is said to have fulfilled every expectation in actual practice. Where tools of one style are made in different sizes a table accompanies the descriptive matter, setting forth the various sizes, principal dimensions, lifting power, weight, etc., and the price. Every shop manager should have a copy of this catalogue and keep informed on the subject.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 9-15 Murray Street, New York City.

HAWAII AND THE PHILIPPINES.—Send 4 cents (in stamps) for an illustrated booklet issued by the Chicago, Milwaukee & St. Paul Railway, the direct route across the American continent to the new trans-Pacific possessions of the United States. Full of latest reliable information and valuable for reference. Can be used as a text book in school. Address William Kelly, Jr., G. E. P. A., 381 Broadway, New York.

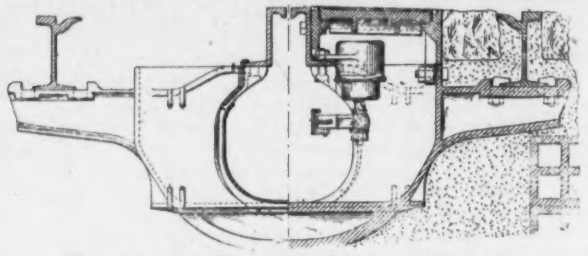
ILLUSTRATED RECORD OF ELECTRICAL PATENTS

UNITED STATES PATENTS ISSUED NOVEMBER, 1, 1898.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

613,286. EMERGENCY FUSIBLE CUT-OUT FOR ELECTRIC CIRCUITS; C. H. Long, of Louisville, Ky. App. filed July 10, 1897. In an electric switch, the combination, with the opposed wire plates, spanned by the fusible wire and opposite ones of said plates having sockets or contacts, of the laterally-movable switch adapted to engage one of said sockets or contacts, and having the fusible wire connection with one of the opposite end plates.

613,293. MECHANISM FOR SUPPORTING ELECTRIC ARC LAMPS; W. A. McCallum, of Avondale, Ohio. App. filed Nov. 18, 1895. The mast-arm head carrying the contact holder, and the contaet carriage, and the lamp suspended from the carriage, the mast arm being hollow, and the carriage moving therein, and the rod connected to the carriage for reciprocating the latter, and located within the arm, and an opening through the mast through which the rod plays, substantially as described.

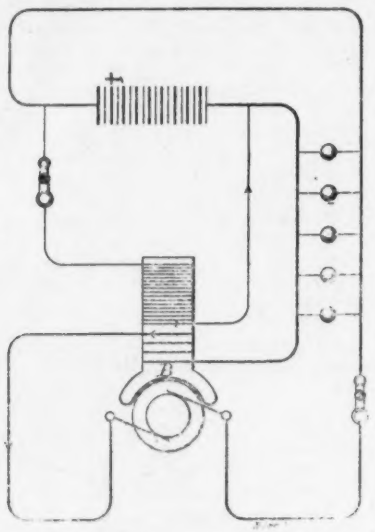


No. 613,301.—Yoke for Railway Conduits.

613,301. YOKE FOR RAILWAY CONDUITS; F. S. Pearson, of Boston, Mass. App. filed Nov. 4, 1897. A yoke for railway conduits, having a hollow central portion and detachable manhole-curbs flush with the surface of the roadway, substantially as described.

613,348. PRINTING TELEGRAPH; A. Wirsching, of New York, N. Y. App. filed May 10, 1897. In a printing-telegraph instrument, the combination of a hollow shaft, a type-wheel, a carrier adapted to travel through the interior of said shaft and connected with and controlling the movement of said type-wheel lengthwise the shaft, means for moving the carrier through the shaft step by step.

613,406. ELECTRIC CAR LIGHTING; W. Biddle, of New York, N. Y. App. filed May 14, 1894. The combination in a system for lighting cars, of a dynamo having an armature rotated by a connection to the car-axle, an external circuit from the commutator containing incandescing lamps in multiple arc, a secondary battery in series in the external or working circuit, a helix of the field magnet in a shunt to the secondary battery and a reverse wound helix in the main circuit for unifying the action of the dynamo under varying speeds of rotation of the armature.



No. 613,406.—Electric Car Lighting

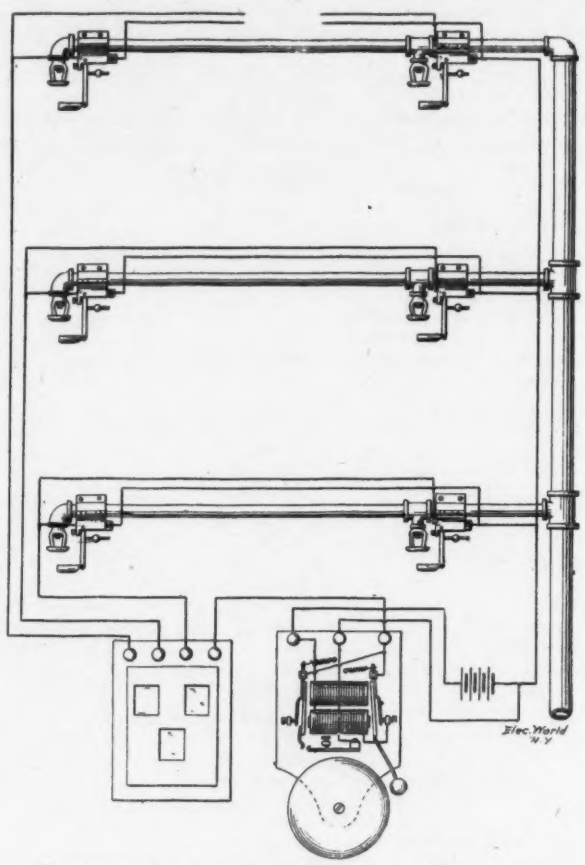
613,418. ELECTRIC RAILROAD; C. L. Kemery, of Pittsburg, Pa. App. filed Jan. 12, 1898. An electric railway system comprising a conduit having current wires arranged in the bottom thereof, a series of conducting plates or bars arranged in said conduit and insulated from each other by a strip and from the conduit by suitable insulating material, hangers secured to said insulating material, a series of conducting strips connected together by non-magnetic conductors and suspended in the said hangers, connections between the said strip and the current wires, contact rollers, a magnet suspended from a frame and supported by the shaft directly above the conducting plates, whereby the conducting strips are drawn into contact with the conducting plates, substantially as described.

613,533. TELEPHONE BOX OR CABINET; I. Sparks, of Santa Fé, Territory of New Mexico. App. filed March 22, 1898. In a telephone cabinet, the combination with a box formed thereon of a partition for dividing the said box into an upper and lower closure, a movable front for closing the upper closure, adapted to carry a portion of the call mechanism, means for locking the said front board in its closed position, a removable top board provided with means to engage detents mounted on the inner surface of the front board, and a door for the lower closure, substantially as described.

613,549. GRADE-CROSSING SIGNAL FOR RAILWAYS; H. McLean Abernethy, of Elmira, N. Y. App. filed September 9, 1897. The combination with a railway grade-crossing signal of a track instrument electrically connected with the signal and comprising a rotary shaft, a sleeve mounted on said shaft and insulated on a portion of its periphery, a fly-wheel and a ratchet wheel on said shaft, contact fingers bearing on said sleeve, and means operated by a passing locomotive or train for operating said ratchet wheel.

613,567. BLOCK-SIGNALING APPARATUS; T. T. Fogel, of Allentown, Pa. App. filed Dec. 6, 1897. In a signaling apparatus, a target, a solenoid and an armature therefor pivotally connected with said target, an electric circuit, a circuit closer therefor, comprising a brush and a disc, a solenoid and an armature therefor, and means carried by said second armature for directly engaging and operating said disc.

613,594. ELECTRICAL FUSE-WIRE HOLDER; W. D. Packard, of Warren, Ohio. App. filed Sept. 29, 1897. The combination with an insulator having terminals of a translucent casing projected outwardly from said insulator, a removable fuse-wire holder located within said casing, the fuse wire being in electrical contact with said terminals, and a yielding bearing for said holder, substantially as described.



No. 613,636.—Combined Leak and Fire Alarm.

613,612. ELECTRIC RAILWAY SYSTEM; L. E. Walkins, of Springfield, Mass. App. filed May 20, 1898. In an electric railway, the usual car-track rails, the intermediate rail conductor, and a rail conductor mounted along outside of one of the track rails, a continuous longitudinally extending receiver therefor, having a portion thereof extended above the top of the rail and serving as a guard between the conductor rails, substantially as described.

613,636. COMBINED LEAK AND FIRE ALARM; H. I. Lurye, of New York, N. Y. App. filed Nov. 19, 1897. A pipe or conduit provided with a sprinkler, and with longitudinal ribs, and a hanger and transverse arms or conductor carriers, combined with a lever fulcrummed between the ribs, a stop for the lever carried by the hanger, and a circuit closer connected to the lever and to a conductor carrier, said lever having a receiver or dish placed in proximity to the sprinkler, substantially as described.